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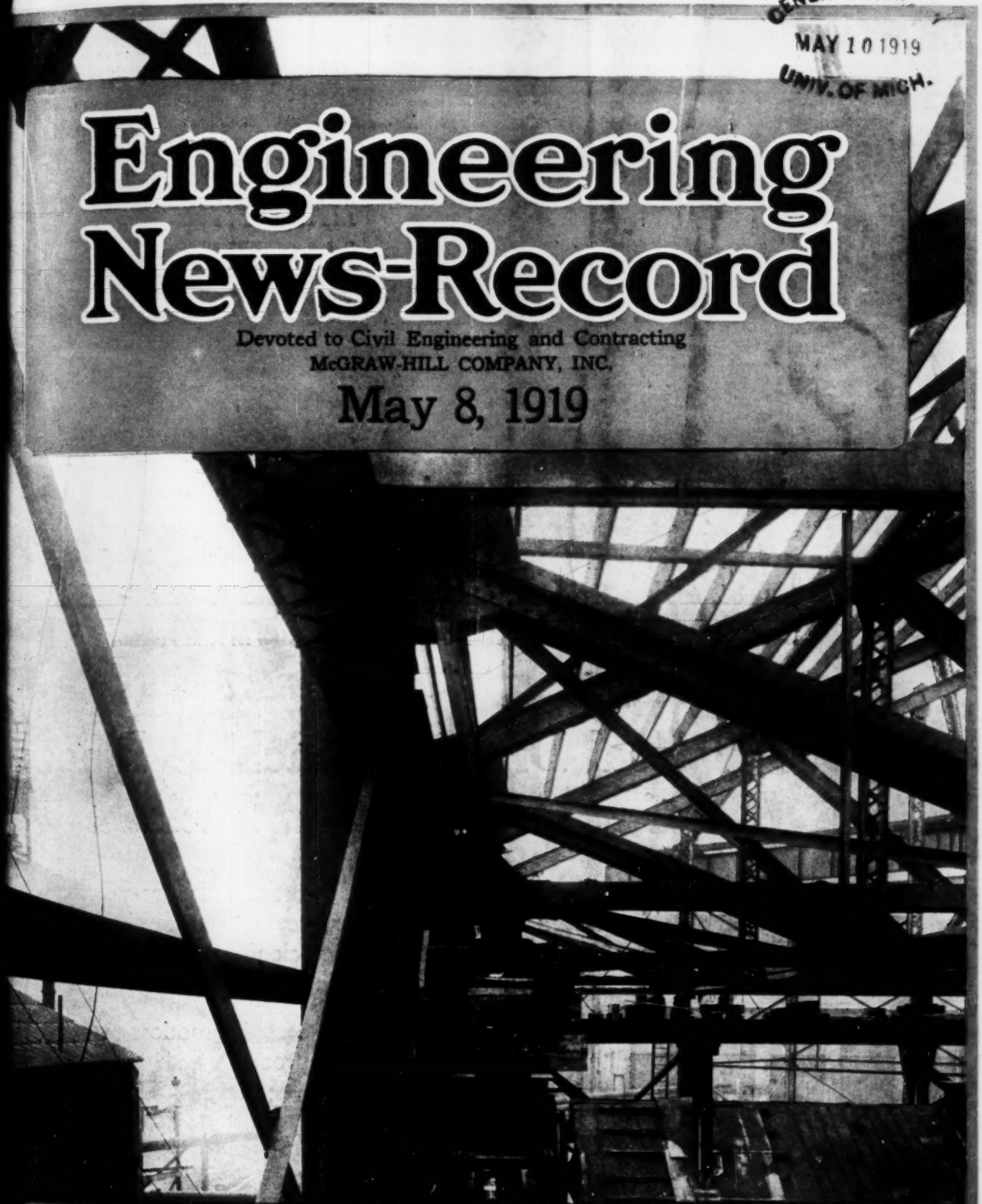
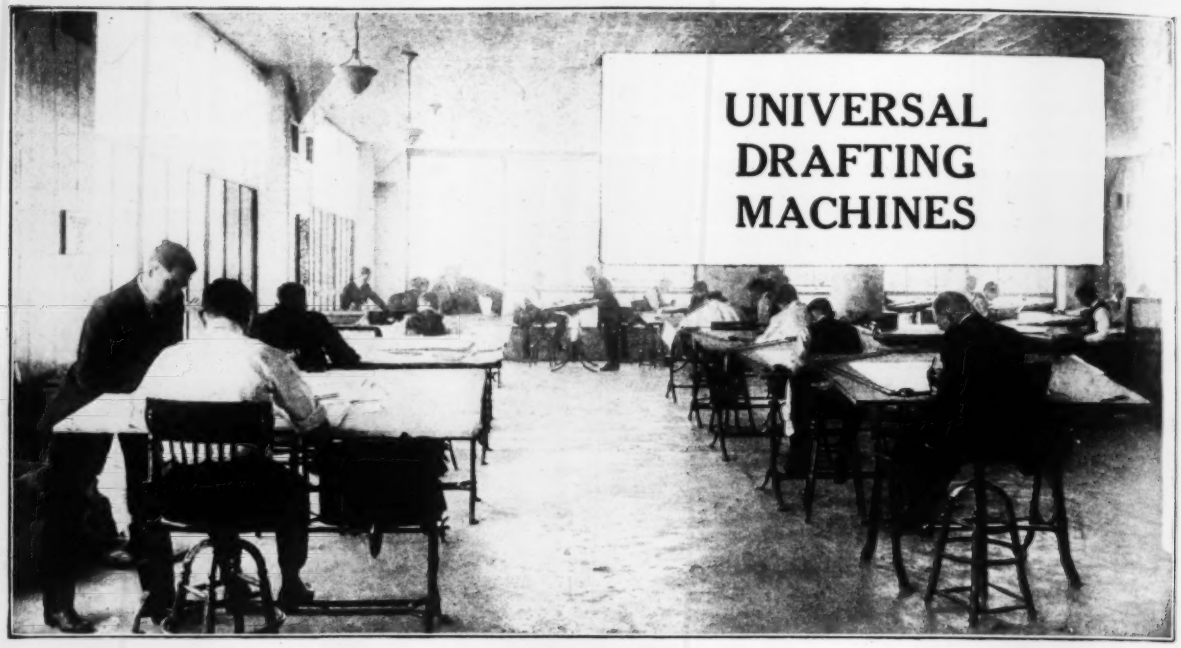


Heavy Roof Built Over Steel Mill by Rolling Method

Remarkable results are being achieved by work now in progress at the Crucible Steel Company's Harrison, N. J., plant. To erect a new long-span building over and around a steel mill without interrupting its operation, a method adapted from bridge practice is being applied successfully. The side columns and crane girders of the building are set and then utilized as track, on which groups of four trusses, weighing 800 tons, are rolled to place over the old structure below.

Also in this issue:

New Illinois Designs for Rigid Pavements, by Clifford Older



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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor*

CHARLES WHITING BAKER, *Consulting Editor*

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Catching Up With Deferred Maintenance

DURING the war maintenance was quite generally deferred in every branch of activity, including not merely the industries and the railroads but our homes as well. If the views commonly entertained in the business world are correct, the time is not far distant when we shall face a labor shortage. With the tide of emigration that is expected to set outward when peace is concluded, and with the reawakening of business, it would not be surprising to find this shortage as early as next autumn. Now, however, there is an oversupply of men. Of that we have testimony from the industries as well as from the Government. This, then, is the time for catching up on our deferred maintenance. Prices are high, without a doubt, but there is general agreement that marked retrogression is not to be expected. Moreover, the damage done by lack of maintenance proceeds in a ratio that is geometrical rather than arithmetical. In other words, maintenance that is kept up from time to time proves less expensive than when it accumulates. While, therefore, the cost of catching up on our maintenance now is much above what it would have been if done when first required, it is less now than it will be at a subsequent time. The crucial factor, too, is men, and they are available now.

Departing from Beaten Paths

AS IN every art there are problems and expedients that go beyond the scope of the instruction books, so in engineering by no means all planning and building follow the methods taught as standard. Even in structural practice, which on account of its precision and elaborate literature might appear to be an exception, this truth holds. It is demonstrated in a picturesque way by a piece of bridge reinforcement described on another page of this issue. A fundamental principle requires the members of articulated structures to meet centrally; yet in the present case gross and deliberate violation of this principle was found to be good engineering. A tension chord that should be straight or smoothly polygonal was arranged in zigzagged alignment in order to satisfy most effectively the special stress requirements of the case. Obviously, the engineer's skill and resource are put to a very different test when he creates such a precedent-ignoring construction than when he applies normal methods, no matter how precisely or how efficiently. And it may fairly be said that a command of standard methods alone, without the ability to strike out a new path when occasion demands, is but high-grade mediocrity. Where, however, is the student of engineering to acquire the necessary boldness and constructive power of thought? Do the methods of teaching bring it into being and develop it? Progressive educators, we believe, are keenly mindful of this desideratum and endeavor to provide for it. But unquestionably the study of original work on the part of others, as described in current literature, will prove a powerful aid.

Two Elements of Originality

IN THE remarkable roof-erection work described in this issue, two particular elements of originality are brought into view. One of these lies in the fact that the general method was borrowed from bridge practice. Most minds tend to erect fixed partitions between different fields of activity, preventing them from seeing similarities and analogies; yet those who are readiest to see analogies will surely be most fertile in original expedients. No doubt, it is proper to make separate mental pockets for building erection, bridge erection, and ship erection; there are essential differences between these subjects, to ignore which would breed confusion of thought. But the man who, while appreciating these differences, is able to borrow wisely from the one subject in order to benefit another is the successful originator. Developing their working method by this very procedure, the erectors of the Crucible Steel building have done—or rather, are doing, for the work is still in progress as we write—a remarkably successful piece of work. Yet their method is exceedingly simple, especially so when it is considered that the problem was set by unusually severe demands on the part of the owners. This leads up to the second element of originality which the present case brings out: No matter how well the methods of doing a thing are standardized, the spur of an abnormal demand sets the mind to work finding other ways of doing it. Necessity is the mother, etc.

Eliminating the Side Ditch from the Highway

IT IS generally admitted, as contended in an article by W. P. Blair on p. 914, that the highway side ditch is a nuisance. Evidently, a comprehensive system such as that advocated by Mr. Blair would no doubt satisfactorily take the place of the ditch and solve the drainage problem in many soils and under many conditions. But a large number of engineers still regard a clean ditch as the surest and quickest way of removing water from the highway. It has the advantage, at least, of being open to inspection. Indeed, the problem of inaccessibility is one of the chief arguments used against tile by those who do not favor underdrainage. How to keep the tile from filling up with roots, and how to arrange them to drain subsoils which are practically waterproof, such as clay, appear to some engineers to be

unsolvable problems. If with impervious soil conditions the system proposed will not function, it would be well to consider the plan of covering the entire subgrade with a 3- to 4-in. blanket of gravel or crushed stone. This would carry the water to the longitudinal drain and would make unnecessary the lateral tiling and the consequent trenching of the subgrade, always an undesirable procedure. Obviously, such a design is expensive, but, with the high cost of permanent pavements, would not the additional expenditure be a profitable investment? The growing importance of better drainage, on account of the increased first cost of road surfacings, will warrant the engineer in giving to this problem, upon which the permanence of the improvement most largely depends, his best attention.

Army's Own Construction Is Not Public Works

INCLUDING the Construction Division of the Army in the proposed Department of Public Works was apparently inconsistent on the part of the engineering societies' conference held in Chicago last week. It may prove to be injudicious. The second paragraph of the code of principles set forth by the conference stated that the Department of Public Works should "comprise those works which are built and operated for the use of the public." This distinctly eliminates the Construction Division, which is a war creation charged solely with the construction, maintenance and operation of structures in this country used by the Army itself. Although the war emergency forced this division into most elaborate projects and provided it with an admirable personnel, its essential purpose is the same as was that of the peace-time construction branch of the Quartermaster Corps. So far as the Public Works Department is concerned, it differs in no way from the Bureau of Yards and Docks of the Navy, which was apparently not even considered as a possibility in such a department. Such a distinction will only give a weapon to opponents of the proposed department. The defense of the inclusion seems to be that the great warehouses and port terminals are foreign to the field of the Army engineer. That is true, but that which we propose to create is a peace-time organization. In time of war the War Department might call on it to aid in building construction, but to take out of the Army the doing of its normal building work not only violates the principle that only work for the use of the public is to be included in the proposed department, but opens the proposed bill to unnecessary attack.

Educating the Public On Engineering Matters

DISTRIBUTION of technical information for the instruction of the public is a useful activity of the engineering department of the Kansas State Agricultural College. Technical articles are prepared on subjects of local interest, such as irrigation and drainage, in language easily comprehended, and are sent on request to the local press and to farm journals. This development of the college-extension system may be classed with the well known short courses in highway and drainage work, in their influence on the community. The press is merely a different vehicle. By its means, information may be supplied on matters of local interest, such as good roads, land reclamation, street paving or the water-supply and sewerage facilities of small towns. Articles of that sort do not displace the engineer. Rather, they educate the public concerning the purpose and importance of the engineer's work and its bearing on the welfare of the community. While many universities have publicity agencies, in most cases the bulletins and news sheets inform the public about the work and activities of the institution. The Kansas idea differs in supplying the public with data about engineering matters in which it is directly interested.

Appreciation of the Place of the Local Society

TEN years ago the local engineering society was scarcely a factor in the organization of the profession; five years ago it was just beginning to function well. Today it is one of the chief elements of strength in professional organization. The national societies as such have recognized this, through their support of the local-section movement, but it has remained for the secretary of the American Society of Mechanical Engineers to go full length in support of the local societies. In the March *Journal* of the society Mr. Rice says: "I am unreservedly for developing and supporting the local society first of all. After one has done his full duty locally then he may join that national society which best serves his specialty." That is good doctrine. The profession will become strong nationally by becoming strong locally.

Latin and Greek for the Engineer

DEAN Cooley's views on the place of Latin and Greek in the training of the engineer, reported elsewhere in this issue, will come, we are sure, as a surprise to most members of the profession. Engineering, as it is taught today, has little or no relation to the world that preceded the eighteenth century. If there is no sympathy with the Elizabethan period, why should there be any thought in the minds of the men of science for a world that seems hopelessly ancient? All the more reason, therefore, for the shock that will come to engineers when it is proposed that Latin and Greek be part of the pre-engineering curriculum.

Dean Cooley sees the need for men broadly educated, and, seeing that, he takes the very logical position of pleading for a type of education that confessedly turns out broad men. He does not contend that purely scientific education cannot produce breadth. We take it, however, that he feels very decidedly that such education has not produced breadth. We should like to see the proponents of a purely scientific education cross swords with Dean Cooley on this matter. It would tend, at the very least, to bring home to us some of the fundamentals of education.

For our own part, we must confess that we have seen more breadth come out of the colleges of literature and arts than out of the engineering schools, and we have hoped that in the development of our engineering colleges such methods or such thoroughness might be introduced that would produce the desired result in breadth and culture. So far, however, the literary schools have the better of the argument. Obviously, the problem is a complicated one, and the length of time available for education must be considered.

Dean Cooley has thrown down a gage which, if taken up, should produce a valuable as well as interesting discussion.

Uniform Slab Strength for Heavy-Traffic Roads

WITH the tendency toward heavy, concentrated loads in highway transportation, the problem of design has ceased to be limited to the questions of smoothness of surfacing and of enough mass to resist wear for a reasonable length of time. Sufficient load-bearing and beam strength to resist immediate destruction is now essential. The desirability of determining the maximum loads to be expected, in order to design all types of road subject thereto for equal strength, can hardly be questioned. This principle has been recognized in drafting the new specifications for main highways in Illinois, as discussed by Clifford Older, chief state highway engineer, on p. 905. A standard concrete road has been designed, and all other types have been proportioned to have the same beam strength.

While most engineers will indorse the principle, there is likely to be disagreement as to the correctness of the assumptions made in arriving at designs of other types to approximate the concrete standard. The changes in many, if not most, of the pavements are radical, raising materially the relative cost of some types with respect to others. Questions are bound to arise: Have proper values been assigned to the components of combination slabs? Has sufficient allowance been made for the cushioning effect of certain surfacings? Why are such revolutionary changes necessary in pavements which have given satisfactory service on heavy-traffic city pavements heretofore? Frank discussion of these and allied questions should bring out points of view and data, based on experience, which should be of material assistance to highway engineers. We are certain that Mr. Older will welcome discussion on the technical merits of his method of procedure.

We shall without doubt all agree on one conclusion, as the result of the discussion: That there is sad lack of data on the beam or slab strength of different types of pavement. One other factor has been repeatedly stated—the lack of agreement as to assumed conditions of support which should be accepted as standard in investigating the load-carrying strength of a pavement slab.

Manifestly, we have been injected into a new set of problems by the advent of heavy highway loads. There is need for the sort of inquiries which Mr. Older's procedure stimulates.

Advance in Subaqueous Tunneling

TWENTY years ago the construction of a soft-ground tunnel under a river ranked among the most formidable and hazardous tasks of engineering construction. Interruptions, delays and fatalities were normal accompaniments of such enterprises. The art has advanced greatly within the past generation. Difficulty and hazard have been so reduced that today a subaqueous tunnel is hardly a much more serious undertaking than any open-excavation contract.

With the completion of the fourth pair of rapid-transit tunnels under the East River at New York—a fifth pair is nearing completion—and the opening to traffic of the second pair, the progress of the art has recently received significant emphasis. Three pairs of these tunnels have been begun and completed within the past five years, substantially without incident; high rates of progress have been attained, the finished structures are of excellent character and precise in grade and alignment, and the casualty list has been kept remarkably low. Yet the East River subsoil, comprising rock, sand, gravel and mud, presents all the classic complications of the most difficult problems of tunneling. Compared with the tunnels built a dozen years earlier from the Battery to Joralemon St., the four new pairs, at South Ferry, Old Slip, 14th St. and 60th St., have a history of remarkably greater success. Their completion marks the end of a long development period of cast-iron-lined shield tunnel construction.

Refinements in the application of well known methods, rather than the introduction of new methods, are to be credited for this result. The shield-and-compressed-air method has been known for many decades past, and the shields in use today differ only in minor constructional features from those of prior tunneling operations. Cast-iron tunnel lining and the methods of putting it in place and making it secure also contain nothing new. Nor is the practice of dumping a temporary fill into the water overlying the tunnel in any respect new. But rigid control of the work, and systematic care and vigilance throughout, in the regulation of exposure of men to the compressed air, as well as in the guarding of the face and in the grouting, have permitted the utilization of these elements with increased efficiency.

Thus, it is now recognized that the blanketing of the river bottom with clay has such an important bearing on success as to justify large expenditure for this item. Formerly, tunnel builders were inclined to economize in the first blanketing, and they usually had to reinforce and repair the blanket subsequently, when heavy leaks or blowouts showed it to be weak. The view taken today is that it is cheaper to prevent a blowout than to plug it. To adequate blanketing alone may be given much of the credit for reducing the tunneling hazard as well as for making possible high rates of advance. Consistent care in handling the face work, however, and conscientious survey checking and control of shield movement, are other factors fully as important, influencing the safety and expedition of the work as well as its exactness.

There is a particular satisfaction in contemplating the approximate perfection of tunneling exhibited in the East River work, because it affords a sound basis for the development of future possibilities lying beyond the range of past experience. It is not to be expected that subaqueous tunnel construction will forever be circumscribed by present limits of size and depth. Indeed, the project for a road tunnel under the Hudson River may carry the art quite beyond these limits within very few months, if the project for a tube of 42-ft. diameter, which General Gothals recommended a year ago is adopted for execution. But ordinarily progress is not made by such great leaps into the unknown; it builds up step by step on a foundation of well worked-out experience, constantly venturing ahead but remaining always within reach of the accomplished. In progress of this kind the East River work, together with the pioneer engineering done in the present Hudson Tube tunnels and the Pennsylvania tunnels, will constitute the solid ground of departure.

A record of what was done and learned in the rapid-transit tunneling still remains to be written. In the rush of building, the engineers have not found time to note down their experiences for the use of posterity. As the work approaches its final stages, however, we may hope that the record will be written, and made available, in printed form, to all engineers.

Erecting Long-Span Roof Over Steel Mill By Rolling Trusses to Place

Rebuilding of Crucible Steel Company Mill Involves Remarkable Roof Construction—Erection Method Adapted from Bridge Practice—Trusses Rolled Along Craneway in Groups Weighing 800 Tons

DIFFICULT requirements presented by the reconstruction of a large rolling-mill building at the Crucible Steel Co.'s Harrison, N. J., plant are being met in highly successful manner by methods new to building erection. The well known bridge rolling procedure has been adapted to the case, and by its help a roof of unprecedented proportions is being erected over and around the rolling-mill unit of the plant while furnaces and mills remain in full operation, as indicated by the view, Fig. 1.

Three old buildings, occupying a space about 200 x 380 ft., at present contain the rolling mills and their heating furnaces. Upon completion of the new building surrounding them, a structure 240 x 390 ft. having no interior columns whatever, they will be taken down with the help of the traveling cranes of the new building. The machinery will remain in service undisturbed throughout the work, and ultimately may be rearranged in the clear floor area as desired to suit the improvement plans.

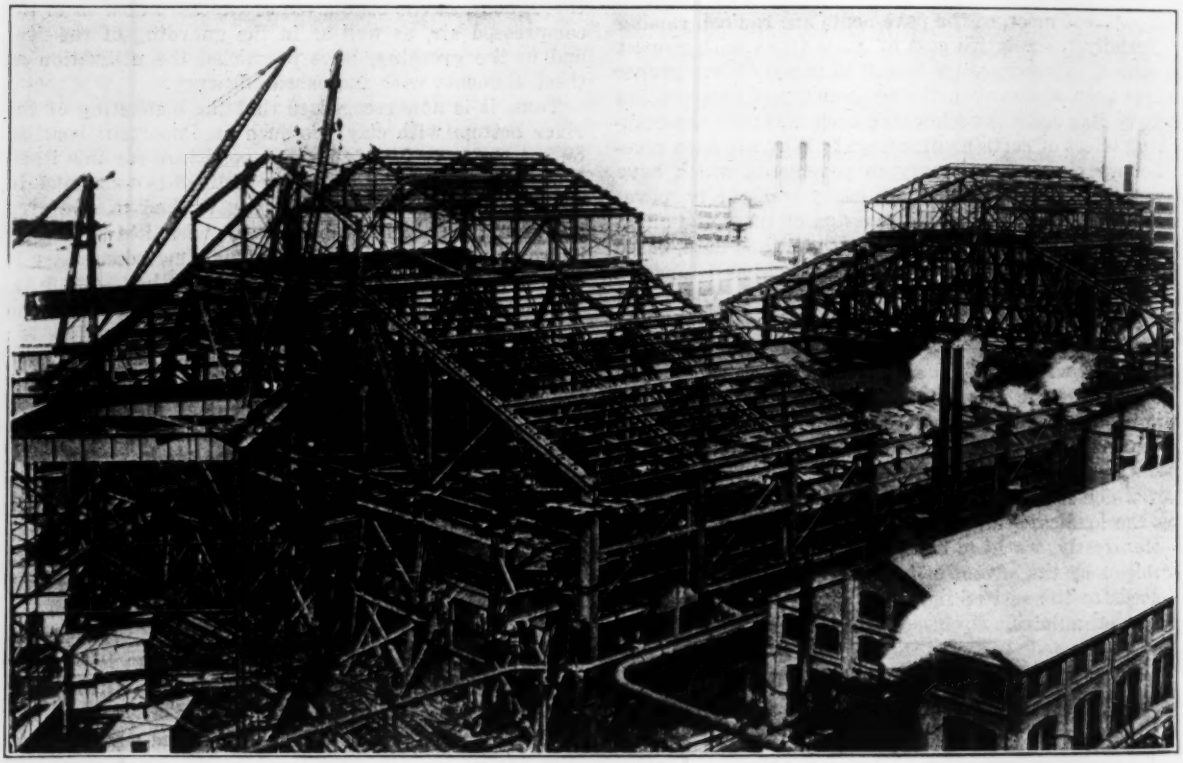


FIG. 1. SECOND GROUP OF FOUR TRUSSES OF CRUCIBLE STEEL COMPANY ROLLING MILL READY TO BE ROLLED TO PLACE—VIEW FROM SOUTHEAST

In the expansion of the plant that has been going on for four years, modernization of the rolling-mill unit formed one of the most difficult items. The old three-bay building which houses it (see sketch Fig. 2) is low, dark and much obstructed by columns and timber longitudinal trusses; it lacks adequate crane facilities and is not adapted to change or regrouping of the furnaces and mills. Renewal, however, was complicated by the necessity for maintaining the machinery in full operation. Every foot of floor space is in use, and there was no room for placing either columns or falsework inside the building. Moreover, the plans for the future development of the rolling mill, as projected by William H. Taylor, chief engineer, required that the new building be clear of columns, so that it would be possible to rearrange and alter the equipment at all times unhampered by limitations on the use of the floor space.

Within the past year a long-span roof of radically novel structural arrangement was designed and built to house a new press and forge shop at the plant. The successful completion of this structure was followed by the design of a long-span structure for the rolling mill. this roof, now being erected, contains the longest simple trusses in any mill-building roof yet built, 235 ft. 9 in. between centers of columns. The trusses carry not only the roof loads but also two pairs of crane-runway girders, which provide three 73-ft. craneways side by side, each running the full length of the building.

It was impossible to put up falsework for erecting these trusses in place, and their size and their great

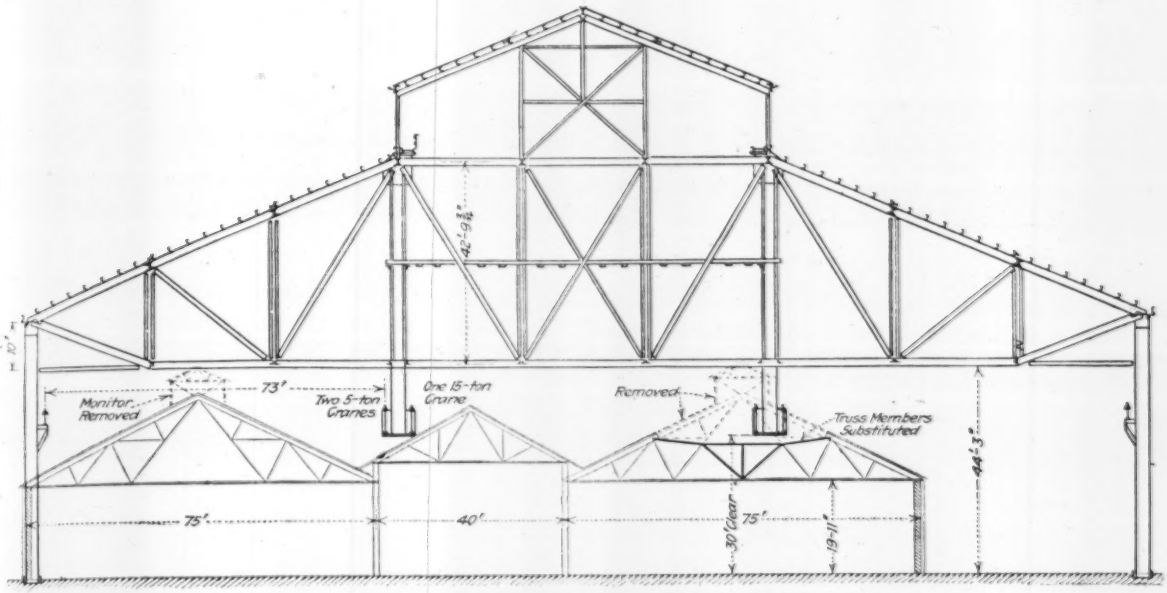


FIG. 2. RELATIVE POSITION OF OLD ROLLING MILL AND NEW LONG-SPAN ROOF; OLD ROOF RECONSTRUCTED TO AVOID INTERFERENCES IN ROLLING

weight—100 tons per truss—made it impossible to swing them to position from the side. The use of the rolling-to-place process often resorted to in bridge renewal overcame the difficulty; in fact, the design was made on the basis of this method, proposed by the erection department of the American Bridge Co., contractor for the building.

The trusses are being erected on staging at the south end of the building (Figs. 4 and 5) and are then rolled along tracks supported on the outer crane runways, sup-

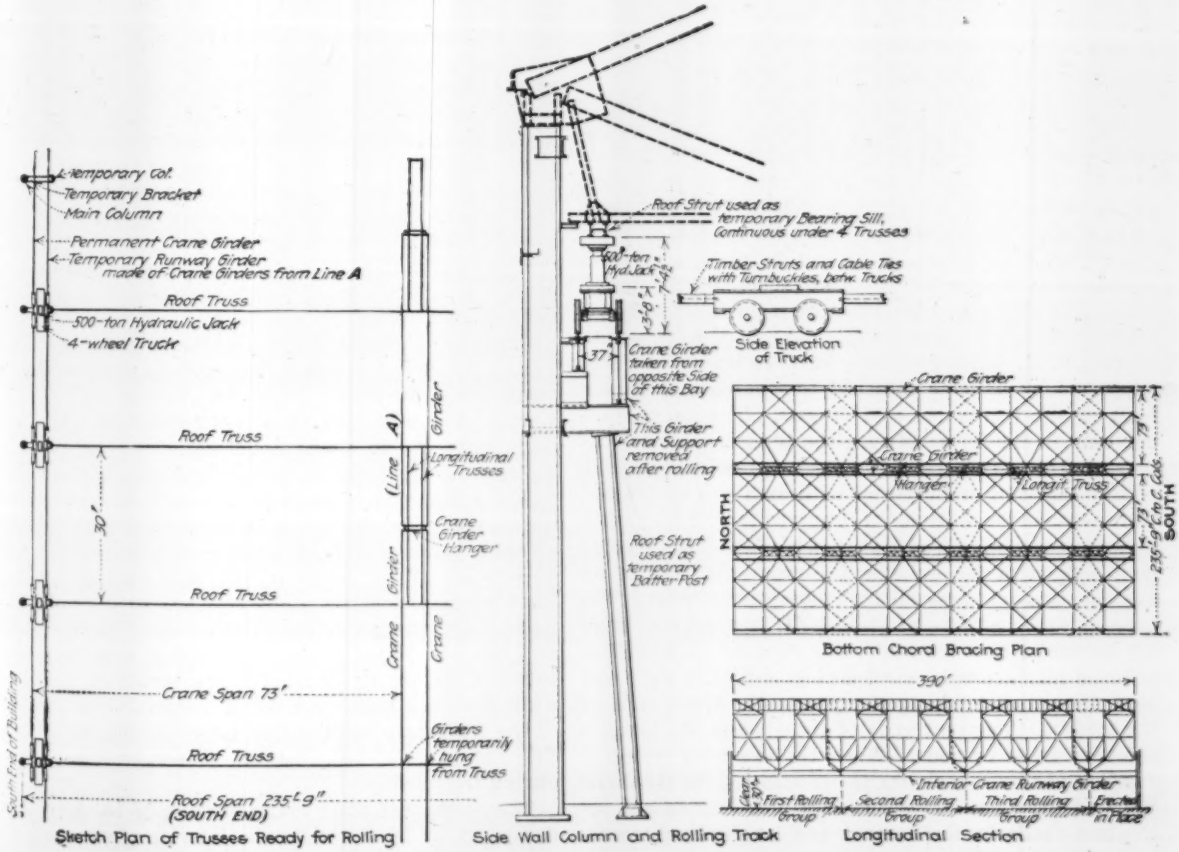


FIG. 3. UTILIZING COLUMNS AND CRANE GIRDERS TO FORM ROLLING TRACK FOR TRUSSES

plemented by additional girders (see sketches in Fig. 3) borrowed from the interior runways. This ingenious expedient of using the side-wall columns and their attached crane girders, supplemented by other girders, for track on which to roll the trusses (see Fig. 4) enables the work to be done very economically and simply. Design and erection procedure being worked out in close coöperation, it was practicable to suit the unusual erection requirements at almost no sacrifice of extra material. J. B. Gemberling, division manager of erection, and J. Sherrard, district erection superintendent, are in charge of the work for the contractor.

At the front of the building, over a low transverse bay, it was possible to set up timber horses, partly within the building, to support an erection platform on an area 30 ft. deep across the full width of the building. This affords room for erecting two trusses. When they are swung, and the bracing, purlins, crane-runway drop brackets and crane girders are in place, the pair is jacked up on four-wheel trucks under the ends of the trusses and rolled back. According to the original plan for the work, this group of two trusses was to be moved back to its final place in the roof. But it was later decided that time could be saved by moving in groups of four trusses. The pair is therefore rolled back only 30 ft., giving room for erecting a third truss and its panel of purlins, and again rolled back 30 ft. for the erection of the fourth truss. The group of four, shown in the view, Fig. 5, is finally rolled back to its intended position in the building, this move proceeding in the same way as the shorter move, but requiring special rigging of the derrick hoist lines to do the hauling. When the group of four trusses is landed it is complete and self-contained, requiring only connection to the columns and attachment of the intermediate crane girders to their truss hangers.

No material could be erected in the final position of the roof trusses except a few light parts such as the purlins of the intermediate panels. It was necessary, therefore, to design the interior crane-runway system in such a way that the 4½-ton panels of girder between successive groups of trusses would be carried by these groups, as they could not be put in place afterward. Reference to the plan in Fig. 3 will show how the design meets this difficulty. Except at extreme front and rear of the building, the crane girders are made in two-panel lengths, 60 ft., joining half way between trusses and here supported by hangers attached to longitudinal trusses between the transverse roof trusses. The hangers occur only in the bays between the braced pairs of roof trusses. This structural arrangement permits the rolling of two panels of crane girder with each pair of trusses, and so avoids the difficulty of intermediate girder panels.

In the erection of a pair of roof trusses on the staging on the front of the building the crane girders are set first, resting on cross sills of the staging bents. The ends of these girders project 15 ft. to rear and front of the respective trusses. The forward longitudinal truss is also erected, cantilevering out from the front roof truss, and its hanger supports the front ends of the girders. The rear ends of the girders are hung to the rear truss by rods. When the two-truss group is swung and moved back, for the erection of the third and fourth trusses, the second 60-ft. girder lengths are put in place similarly, the hangers and longitudinal trusses erected between the pairs to support the junction point

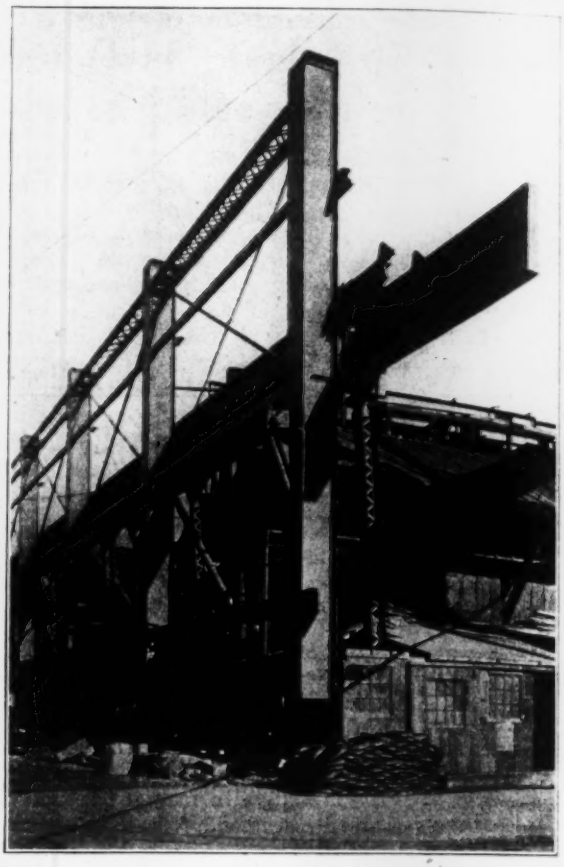


FIG. 4. SIDE COLUMNS AND CRANE GIRDERS FORMING TRACK FOR ROLLING TRUSSES

of the girders, and the rear ends again supported by temporary rods hung from the rear truss. The rear longitudinal truss cannot be erected at this stage because of interference with the erection equipment. In this condition the group of four trusses is rolled; the rear ends of the crane girders do not receive their final support until the next group is rolled forward, carrying the longitudinal truss and hanger of the intermediate panel. The purlins of this panel are placed by a jinny-wink set on the roof.

Trucks and Rolling Track—Utilizing the outer crane girders as part of the track on which to roll the trusses made the equipment needed for the operation quite simple. The view, Fig. 4, and the drawing, Fig. 3, in conjunction explain the arrangement.

For steady guiding it was desired to use four-wheel trucks running on a track of two rails at each end of the trusses. One rail is laid on the permanent outer line of crane girders, and the other on a temporary line of girders set 37 in. inside of this and resting on steel shelf-beams and batter posts attached to the main columns. The temporary line is made up of 60-ft. lengths of girder borrowed from the interior runways. The batter posts are top-chord bracing struts of the roof, while the shelf-beams are extra material; the addition of the temporary construction increases the stability of the side columns, reducing the chance of lateral sway during the moving.

The permanent outer crane girders, 36 in. deep, span one panel, or 30 ft., while the interior girders are designed for the 60-ft. span between hangers and there-

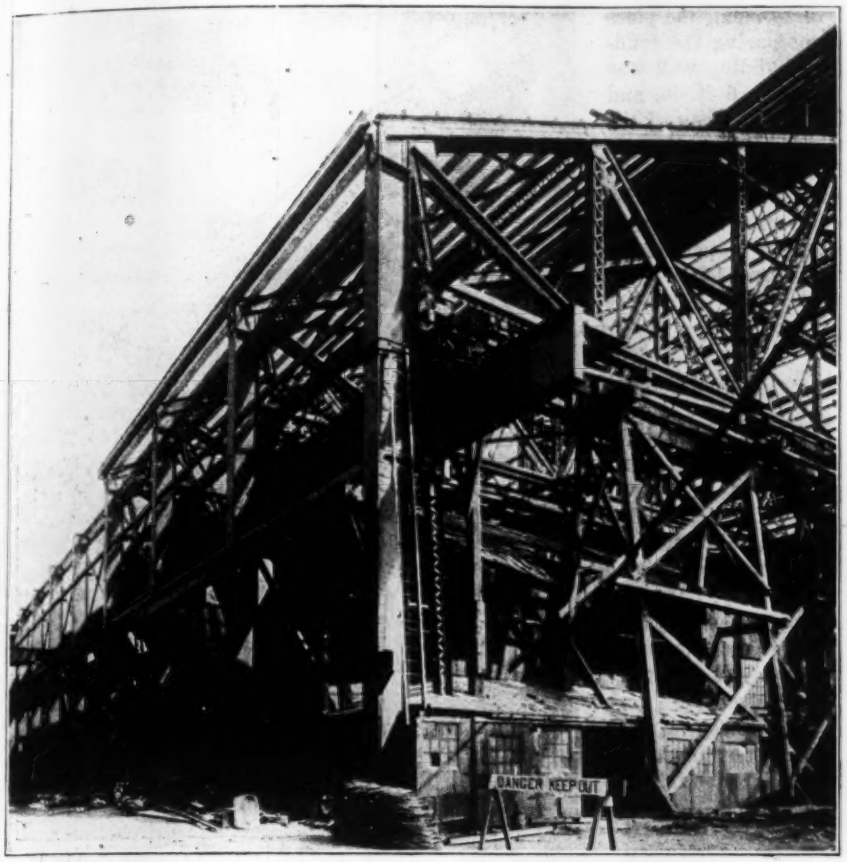


FIG. 5. FOUR-TRUSS GROUP ERECTED AT SOUTH END OF BUILDING, ON FOUR-WHEEL TRUCKS READY FOR ROLLING BACK

fore are made 60 in. deep. When used as part of the rolling track, however, the 60-in. girders are blocked up to bear at the middle as well as at the end supports.

With a truck under each end of each truss, eight four-wheel trucks support one of the 800-ton moving groups (comprising four trusses of about 100 tons weight each, and 400 tons of crane girders, purlins and bracing). Each truck carries a 500-ton hydraulic jack (it happened that smaller jacks were not available), by which the truss end is raised 3 or 4 in. from its seat on the top of the main column and blocked up at this height upon the truck sill, to free it for moving. After the move the jacks similarly lower the group to a seat on the columns at its final location.

Moving the truss groups has turned out to be exceedingly simple and rapid, with this equipment. The hauling line at either end of the truss group is reeved from the hoisting engine through a snatchblock at the front end of the building, thence back to a two-sheave block at the rear end and forward through another two-sheave block attached to the sill of the second truck from the back of the group. This gives a five-part tackle. The four trucks on either side are strutted and tied together by timbers and turnbuckle cables, so that the pull of the line distributes to the four trucks. The two derrick engines at the front of the building handle the east and west lines, and the operators are able to keep the two ends of the group abreast without travel indicators or other special devices.

On Mar. 25, when the first group of four trusses was rolled to place, the move was made in 15 min. The second group was rolled Apr. 15, taking about the same time. The third group of four is to be moved about May 8. This will complete the rolling, as the two southerly trusses will be erected at once in their final position.

Layout for Erection—An unusually convenient erection plant was set up for building the Crucible Steel rolling mill. Fig. 7 sketches the layout. Two derrick towers, built of crane girders and roof-bracing struts in part borrowed from the main structure and in part belonging to a building under contract elsewhere, support two stiffleg derricks fitted with 90-ft. booms. These derricks, regular equipment, are rated at 30 tons capacity, though the extreme lift in this work is 18 tons (end section of top chord) at about 80-ft. reach. The 60-ft. crane girders weigh only nine tons. Because of track interference, these towers had to be set diagonal to the building, but this position worked out very satisfactorily. Material is supplied as needed, coming on cars from a storage space elsewhere in the yard, and is at once hoisted to place. The working space at the front of the building is thus left unencumbered.

A gang of 75 men is employed in the erection work, under Foreman D. McQuarrie and H. Adams.

The side columns, each weighing nine tons, were set

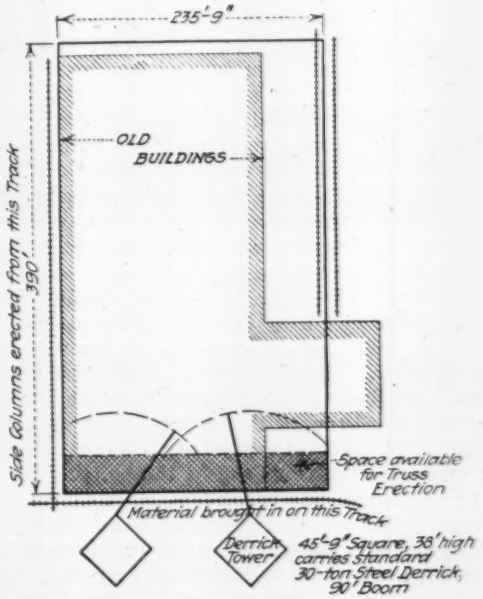

235'-9"
OLD BUILDINGS
Side Columns erected from this Track
390'
Space available for Truss Erection
Material brought in on this Track
Derrick Tower
45'-9" Square, 38' high carries Standard 30-ton Steel Derrick, 90' Boom

FIG. 6. TRACK AND DERRICK LAYOUT

by locomotive cranes running on tracks along the sides of the building. To give room for preparing the foundations and setting the columns, the building wall was replaced by a temporary shelter partition 6 ft. in, and the old side wall was torn out. In the front bay of the building, staging bents as sketched in Fig. 7 were dropped through the roof of the front part of the building and capped with pairs of 24-in. I-beams.

Camber was provided for in the trusses to the amount of 2½ in., of which 1 in. was designed to be permanent dead-load camber, to allow for deflection under crane loads. The blocking wedges indicated in Fig. 7 were set a trifle high, however, to permit of entering the middle section of the top chord easily, and were then slacked off to let the parts adjust themselves to the natural camber determined by the shop fabrication.

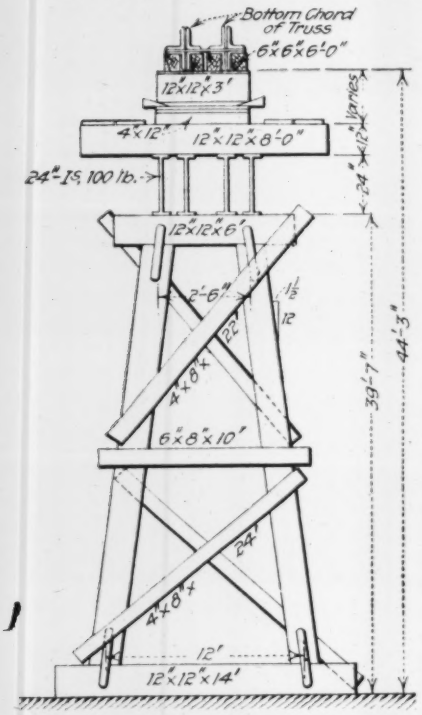


FIG. 7. TYPICAL BENT OF ERECTION FALSEWORK

Returning Crane-Runway Girders—When a group of trusses has reached its final position, the track directly under it is no longer needed. The track girders taken from the interior crane runways must then be moved to the front of the building for erection in a succeeding truss group, since, as already stated, there is no opportunity to set them in position from within.

In part, these girders are dismounted from their seats, lowered, and removed from the building by a locomotive crane running along outside the building. On the larger part of the east wall this is not practicable, however, due to the location of the track and various interferences, and it has been necessary to hang the girders from the roof trusses and telegraph them forward, a rather tedious process in this instance.

As each length of rolling track is removed, short extension brackets originally attached at the rear of the building are bolted to the rear end of the remaining section of track. These brackets are necessary to extend the track beyond the columns at which the rear truss of the next group will be landed, since the rolling truck has an overhang of several feet. Similar brackets are in service at the front end of the building for the outer or permanent line of girders, whereas the inner or temporary line overhangs forward a full 30-ft. panel, since it is made up throughout of two-panel lengths and the building contains an odd number of panels (13).

Reconstructing Old Roof to Clear the New Work—As will be seen from the sketch drawing, Fig. 2, the new trusses foul the monitors of the old roof, and the easterly hangers and crane girders cut into the main trusses of one bay. These conditions made a certain amount of roof reconstruction necessary before the new work could proceed. In the design of the new structure the height was determined by requirements independent of the old building. The monitor interference, amounting to only a foot or so, was easily taken care of by removing the monitor frames and transferring the corrugated-iron roof sheeting of the monitors to the main roof planes.

FIG. 8. ENDS OF TRUSSES CARRIED ON FOUR-WHEEL TRUCKS FOR ROLLING

At the point of interference between the easterly crane girder hangers and the old roof trusses, however, other procedure was necessary. An ingenious reconstruction plan was adopted, involving the substitution of a horizontal chord central section of truss for the peak of the roof truss. The design was such as to permit carrying out the reconstruction operations without shoring. As indicated by the broken lines in Fig. 2, the new chord and web members inserted in the old trusses are so located as to connect to existing gusset plates. Thus they could be attached before the old trusses were disturbed. After they were completed, and capable of taking the load, the ridge members above the new top chord were burned away and removed, and plank sheathing was laid.

Express Trucks—Gasoline and Electric

The American Railway Express Co. employs, in addition to horse-drawn trucks, 1828 gasoline motor trucks, and 1058 electric trucks. The 1828 gasoline trucks are operated in 197 cities—an average of slightly more than nine per city. The 1058 electrics are operated in 23 cities—an average of 46 per city. The ratio is 63% gasoline and 37% electric.

Limestone Rock Asphalt Produces Good Mortar

Tests Show That It Has High Strength, Light Weight and Marked Impermeability—Concrete Results Unsatisfactory

By James R. Nash
Office Engineer, State Highway Department, Austin, Texas

MORTAR made from a natural limestone rock asphalt found in Texas is strong, light and impermeable, according to tests recently made in studying the subject of concretes for ship work. The same aggregate was also used for concrete, but the tests were not very satisfactory, due probably to insufficient mixing and working of materials of this nature. The tests were made with the idea of developing a mortar in which, if incipient cracks should develop due to stresses in the steel, the asphalt in the aggregate would have a tendency to repel water to such an extent that it would prevent sea water reaching the steel.

The aggregate used was a limestone rock asphalt found in Texas, containing approximately 10% of asphalt, the remaining 90% being a comparatively soft limestone. The asphalt is a hard, natural asphalt with a high melting point not unlike the Bermudez natural lake asphalt, but a little harder under ordinary temperatures. The quantity of the asphalt varies from a few per cent. to approximately 14%. The high asphalt content material is called "rich," while that with less than 6% is considered "lean." That which contains about 9 or 10% asphalt is considered "medium."

When heat is applied to a mortar made with this aggregate after it has set and allowed to dry, the asphalt in the stone contiguous to the surface of the mortar becomes soft and is drawn to the surface. A thin covering of a hard asphalt is the result. It is superior to a paint coat of asphalt on the concrete, because the asphalt is part of the aggregate and has therefore a much stronger adherence, and because the heating of the surface tends to melt the asphalt within the mortar, thereby filling up all minute air or water voids in the mortar.

A test made on a mortar disk one inch thick showed it to be impermeable to water under 60-lb. pressure for 48 hours. Three tests were made, and the specimens weighed less after the test than before. The loss was accounted for by the evaporation of water from the specimens; the latter were stored in water until tested.

The strength tests given here are the results of laboratory methods, so it would be necessary to make a field test in a mixer before a definite recommendation could be made. Longer mixing and less water than ordinarily applied to mortar are desirable.

This material is produced commercially by the Uvalde Rock Asphalt Co., of San Antonio, for street construction, by the addition of a flux and heat. For road construction the material is used without heating. The tests were made in the laboratory of the Engineering Division, Bureau of Economic Geology, of the University of Texas.

TESTS OF ROCK ASPHALT MORTAR AND CONCRETE

	Proportions by Volume	Character of Rock Asphalt Screenings	Consistency	Tensile Strength Lb. per Square Inch 7 Days	Tensile Strength Lb. per Square Inch 28 Days	Tensile Strength Lb. per Square Inch 2 Mos.	Compressive Strength Lb. per Square Inch 7 Days	Compressive Strength Lb. per Square Inch 28 Days	Compressive Strength Lb. per Square Inch 3 Mos.	Remarks
Mortar	1:3	Rich (¼ in. to No. 48)	Medium	248	410	...	1,040	1,690	...	
	1:2	Rich (¼ in. to No. 48)	Medium	367	445	...	3,220	3,450	4,040	Permeability and absorption test made from this mix
	1:2	Rich (¼ in. to No. 48)	Medium	...	...	...	1,712	2,425	.....	This test made from identical mix as above, except it was mixed with trowel, instead of by kneading by hand. Considerably more water used in mixing
	1:2	50% Lean (¼ in. to No. 48) 50% Rich (¼ in. to No. 48)	Medium	400	457	545	2,500	3,090	3,980	
	1:2	Lean (¼ in. to No. 48)	Medium	365	453	538	3,080	4,100	4,840	
	1:1½	Rich (¼ in. to No. 48)	Medium	435	497	...	2,970	3,540	.....	
Concrete	1:0.67:2.25	Rich (¼ in. to No. 48)	Sloppy	...	...	...	1,350	1,890	.....	Too much water used. Weight per cubic foot of concrete 118¾ lb. used 10.85 sacks of cement per yard of concrete
	1:0.8:2.25	Lean (¼ in. to No. 48)	Very best	...	...	...	1,815	2,720	3,780	Weight 131 lb. per cubic foot used 10.85 sacks of cement per cubic yard of concrete
	1:0.9:2.80	Rich (¼ in. to No. 48)	Medium	...	...	...	1,245	1,720	2,050 (2 mos.)	

Comparison of Short-Haul Truck and Rail Shipments

Trucks Reported to Be Efficient for 125-Mile Hauls—Freight Delays, Extra Boxing, Clerical Work Prove Expensive Items

MOTOR-truck transportation on short hauls up to 125 miles, when all the factors, such as delays, extra boxing, weight of boxing, etc., incident to rail shipment are considered, will reduce manufacturers' shipping costs for less-than-carload lots considerably. It will also eliminate a number of transportation evils which are both costly and annoying. These opinions were expressed by W. J. L. Banham, general traffic manager of the Otis Elevator Co., in an address delivered before the National Truck Owners' Conference in New York. The Otis company has effected large savings in this manner, according to the speaker. An abstract of Mr. Banham's remarks follows:

Users of motor trucks should consider to what extent they can operate them in competition with rail movements for short hauls. The principles involved are service and cost. In order to make a fair comparison between the two means of transportation, it is important that the manufacturer shall be in a position to know the cost of moving freight by each method to short-haul points. Some manufacturers figure that when a freight rate is 50c. per hundredweight by rail and 75c. by motor truck, that this means a saving of 25c. per hundredweight.

However, this is not a fair comparison of the total transportation cost, which starts with the boxing of the freight and includes all expenses that are incurred until delivery of the goods in good order is made to the receiver.

While some of these charges are hard to separate from general expense, every effort should be made to do so,

as such separation is important in determining the best method of transportation. The accompanying table shows the variation between rail and truck shipments in the neighborhood of New York.

In computing the cost by rail the following items were included: The first-class freight rate, plus 15c. per hundredweight teaming charges from the shipper's warehouse to the freight house, plus 15c. per hundredweight teaming charges from the freight house to the receiver's warehouse, plus 24c. per hundredweight for increased cost of boxing, plus 17% on account of increased weight due to boxing. There is considerable additional expense, which is not included, but will be referred to later. The rate by way of motor truck covers delivery from shipper's warehouse to the receiver's warehouse. It was averaged, and is believed to be a fair tabulation to be compared with the cost of rail movement.

COMPARISON OF COST OF RAIL AND MOTOR TRUCK TRANSPORTATION FOR SHORT HAULS

Haul	Cost per Cwt. Via Rail	Cost per Cwt. Via Motor Truck
From Yonkers to—		
Newark	$1.04	$0.20
From New York to—		
Newark, N. J.	.91	.15
Passaic, N. J.	.91	.18
Paterson, N. J.	.91	.20
Elizabeth, N. J.	.91	.20
New Brunswick, N. J.	.91	.40
Trenton, N. J.	.98	.60
Philadelphia, Penn.	1.02	.80
Chester, Penn.	1.05	1.00
Wilmington, Del.	1.13	1.20
Coatesville, Penn.	1.15	1.05
Portchester, N. Y.	1.02	.63
Greenwich, Conn.	1.02	.63
Stamford, Conn.	1.03	.65
Norwalk, Conn.	1.06	.68
Bridgeport, Conn.	1.10	.70
New Haven, Conn.	1.13	.73
Derby, Conn.	1.13	.73
Ansonia, Conn.	1.13	.73
Shelton, Conn.	1.13	.73
Naugatuck, Conn.	1.15	.74
Waterbury, Conn.	1.16	.75
Meriden, Conn.	1.16	.75
Hartford, Conn.	1.21	.90
Springfield, Mass.	1.25	1.00
Holyoke, Mass.	1.25	1.10
Worcester, Mass.	1.31	1.50
Boston, Mass.	1.36	1.50
Providence, R. I.	1.32	1.10

Factors Making Up Shipping Cost

Taking up the various items responsible for additional expense, the cost of extra boxing may be considered the most important. The amount of this saving, however, will be controlled largely by the amount of material to be boxed or packed, and how much less protection can be used when moving by motor truck as against a less-than-carload movement by rail. In practically every instance it is necessary to prepare material for freight shipment in an entirely different way from that used if it is moved by trucks. This additional packing expense is necessary on account of the number of handlings the less-than-carload shipments received by the railroads and by transfers at both ends. This boxing is generally very much less where truck transportation is used.

Important in connection with this boxing is its weight. This is often increased by moisture from 10 to 25% over the dry lumber weight, where the material is stored out of doors. Also, the extra space required for packing shipments, storing lumber, etc., could generally be utilized to greater advantage for other manufacturing purposes which would produce a profit. Mr. Banham estimated that the Otis Elevator Co. saves $100,000 per year in the cost of boxing, by using motor-truck shipments.

Increased clerical work, delays in transit and, often, loss of shipments are other items which produce extra expense in rail shipment. After the shipment has been properly prepared and the necessary shipping documents have been made out, the shipping department is burdened with an additional expense covering transfer of freight from the shipping floor to the carrier's freight house by truck or other means. If the freight is to be prepaid, the freight bill when rendered must be checked by the shipping department and passed for payment to the interested department. Where thousands are to be handled this checking is expensive. With the use of trucks, this check is made as the merchandise is loaded on the trucks.

It would seem now that the transportation cost has been completed, but in many instances this is not the case. Delays occur in transit, often from six days to six weeks. Where such delays occur it is necessary for the shipper and receiver to locate the freight, and a tracer must be sent out, involving additional expense. Inasmuch as the consignee does not consider that payment is due until the shipment is received, these delays occasion a large loss in capital which might be used for greater manufacturing activities. Where shipments or portions of shipments are lost, as is not uncommon, replacements must be made at further expense.

Contrast this with movement by truck where delivery from shipper to receiver is made within a 24-hour period, with less than half the handling and greatly decreased packing charges. Practically none of the additional expense incurred by rail shipment is necessary when movement is made by truck. If a fixed rate is agreed upon, the shipper is in a position to know at once what his shipping charges will be.

Is it not to the advantage of the manufacturer to make delivery to his customer within the shortest possible time? If a freight shipment takes 30 days by rail, as against one day by truck, the capital tied up might have been used 29 days for manufacturing. It is the best advertising feature of Marshall Field & Co. of Chicago that they agree to make delivery within 50 miles of their store within 24 hours. Prompt delivery gets the business, and slow delivery would lose it.

Broader Commercial Education for Engineers

As a result of a meeting of a committee composed of administrative professors of engineering and commerce at representative higher institutions of learning, and delegates from the four national engineering societies, called to meet in Washington, D. C., by the Commissioner of Education, the following recommendations were made, to be considered by a general conference proposed for the near future: (1) That from 12 to 18 semester hours be required of all engineering students covering the following subjects: General economics, cost accounting, business organization and business law; (2) that for engineering schools desiring to extend further the commercial or industrial aspects of engineering, the following subjects are recommended as electives: Labor and employment, corporation management and finance, statistics, marketing, scientific management, psychology, transportation, and political science; (3) that the economic phases of engineering be emphasized in engineering instruction wherever possible.

Illinois Adopts a Uniform Basis of Design for All Types of Rigid Pavement

Concrete Standardized, Other Types Designed to Equal It in Load-Carrying Capacity—Flexural Strength To Govern—Brick and Bituminous Concrete on Concrete Base Only Other Types Considered for Main Road

By Clifford Older
Chief Highway Engineer, Department of Public Works and Buildings, Illinois

IN VIEW of the rapid development of interurban truck transportation, load-carrying capacity is the logical basis for the design of rigid pavements of different types. In rigid pavements flexural strength is the governing feature, and, having established a standard design for one type, it is sound engineering practice to make all other types conform to it in strength, as nearly as possible. A standard concrete slab, 7 in. at the side and 8 in. at the center for 16- to 18-ft. widths, has recently been developed by a conference of the northern Mississippi Valley states, and this has been adopted by the State of Illinois as the basis for all its rigid surfacings. The only other types considered suitable for the primary road system of Illinois are monolithic brick and bituminous concrete on a concrete base.

Illinois is facing the problem of expending judiciously for road building a state bond issue of $60,000,000, together with about $24,000,000 of Federal-aid appropriation. Practically all of these funds will be used on the main road system of the state, constituting approximately 5% of the total road mileage, and estimated to carry about 60% of the entire state traffic. The design of the pavements to be used on these roads is therefore a matter of the greatest importance.

Rigid Types To Be Used on Main Roads

In this discussion, the rigid types considered are portland-cement concrete, brick on a concrete base and bituminous concrete on a concrete base. Other types of rigid pavement, such as wood-block or granite-block are not considered because they are not available for country road work in Illinois on account of cost. Gravel, water-bound macadam, and the various forms of bituminous macadam are considered to be nonrigid types.

In Illinois, perfect drainage is difficult to obtain in subgrade building. The nonrigid pavements depend almost entirely upon the solidity of the subgrade for their stability. While every reasonable effort will be made to secure good subgrade drainage, yet experience in this state has shown that nonrigid pavements require an excessive expenditure for underdrainage, if serious rutting under heavy traffic is to be avoided.

This condition also necessitates the use of thicker nonrigid pavements than commonly used, and more thorough rolling with heavy rollers to secure the required density of pavement. The stone available for macadam road building in Illinois is a comparatively soft limestone which crushes under heavy rolling. Internal wear under heavy traffic is also a serious matter. These considerations lead to the conclusion that macadam or bituminous-macadam roads, as they may be built practically under Illinois conditions, are essentially light-traffic roads, and cannot be made to bear even moderately heavy truck traffic, except at a first cost which is practically equal to that of the rigid pavements. Gravel roads are subject to the same criticism. The high cost of maintaining nonrigid types under heavy traffic is well understood. These conclusions have led to the adoption of rigid pavements for the main roads.

Any of the three types of rigid pavement considered —namely, concrete, brick and bituminous concrete on a concrete base—has sufficient wear-resisting qualities to make this factor comparatively unimportant. Disintegration due to weather or other natural causes may also, as far as we know, be disregarded in the case of any of the three types mentioned. Available data on maintenance cost do not indicate that this element would be a controlling factor. It therefore follows that the main factor to be considered in the design of such pavements is load-carrying capacity.

It is not the primary function of rigid pavements to span soft spots in the subgrade. The subgrade should be as uniform and unyielding as can be obtained at reasonable cost; but, regardless of the care used, all subgrades are more or less yielding. The function of rigid pavements, therefore, is to provide means for the transmission of traffic loads to the subgrade without exceeding the capacity of either the pavement or the subgrade.

It is fundamental that the load-supporting capacity of a rigid pavement is dependent upon its transverse strength, and its transverse strength is measured by its thickness and the modulus of rupture of the material of which the surface in tension is composed.

Pavement Design Not Subject to Exact Mathematical Analysis

It is generally admitted that with our present knowledge the design of a rigid pavement is not subject to exact mathematical analysis. The forces of traffic, character and moisture content of the subsoil, frost action and other factors are so variable and complex as to defy exact analysis, and any computations must be used merely as a guide to the judgment. *It is reasonable to assume, however, that all types of rigid pavement, provided they are to be used interchangeably under the same soil and traffic conditions, should have equal flexural or transverse strength.*

Under the abnormal motor-truck traffic of last year, failures were observed in practically every type of rural road. In view of these condtions and the increasing use of concrete as a paving material, a conference of the engineers of the highway departments of the northern Mississippi Valley states was recently held for the purpose of standardizing the design of concrete pavements. The aim of this conference was to provide a concrete pavement which, under average soil and drainage conditions, would have sufficient strength to withstand the expected increase in volume and weight of traffic.

For 16- and 18-ft. pavements the design adopted calls for a thickness of 8 in. at the center and of 7 in. at the sides. The concrete to be mixed in the proportion of 1 part of cement, 2 parts of fine aggregate, 4 parts of coarse aggregate, and only sufficient mixing water to give maximum strength. Illinois has adopted this stand-

ard except that a 1:2:3½ mix will be used at least for 1919 construction. This design has also been adopted by Illinois as a standard of strength or traffic-supporting capacity on which to base the design of all other types to be used under the same conditions.

Comparison of Other Pavements With Standard

A standard of strength having been adopted, it is relatively simple to compare it with other rigid pavements. Assuming traffic loads to be equal, the moments producing flexure of the slab will be equal. Also, the results will be relatively correct whether the pavement is considered as a slab or simple beam. For convenience the latter assumption is made.

The modulus of rupture of the pavement may then be expressed by the common flexure formula $S = Mc/I = K/d^2$, where K is a constant which is equal to $6M/b$, and is equal for all slabs of equal strength and proportionate for all slabs of unequal strength, S is the modulus of rupture and d is the thickness of the slab. Then

$$K = Sd^2 \qquad (1)$$

$$\text{or } d = \sqrt{\frac{K}{S}} \qquad (2)$$

For the standard road $K = 459 \times 8 \times 8 = 29{,}400$, using a modulus of rupture for 1:2:3½ concrete of 459 lb. per square inch. Substituting this value of K and the modulus of rupture for any given concrete in formula (2), the thickness at the center line of a pavement of equal strength may be determined. Or, determining K for any pavement by formula (1) will enable a comparison of transverse strength to be made.

The accompanying table gives a comparison of some of the properties of common concrete mixes:

Proportions of Concrete	Modulus of Rupture * Lb. per Square Inch	K for Pavement 8 in. Thick at Center	Per Cent. of Strength of 1:2:3½ Mix (8-in. Slabs)	Thickness at Center Line (c) for Strength Equal to 1:2:3½ Concrete
1:2:3½	459	29,400	100.0	8.0
1:2:4	439	28,100	95.6	8.2
1:3:5	285	18,200	61.9	10.1
1:3:6	226	14,500	49.3	11.4
1:1:2	710	45,400	154.5	6.4
1:1:1½	709	45,300	154.0	6.4
1:2½:4	375	24,000	81.7	8.9

* Obtained from "Concrete, Plain and Reinforced," Taylor and Thompson p. 258.

The results given are independent of the exact values of modulus of rupture, providing these values are relatively correct.

Brick Pavements

Brick pavements have been constructed in many different ways. For several years the Illinois department has favored the monolithic type, as it seems to be giving excellent results. In a report of tests of monolithic brick slabs made at the University of Illinois (see *Engineering News-Record*, of Nov. 1, 1917, p. 820), Prof. C. C. Wiley states, in effect, that the modulus of rupture of the concrete base of monolithic brick slabs is approximately the same as that of plain concrete of the same quality, and that such slabs are fully equal in strength to concrete slabs of the same thickness. The tabulated results of these tests would seem to indicate that a higher modulus of rupture might be expected for the base of a brick slab than for the base of a concrete slab of the same thickness and quality of concrete. However, in the few tests recorded where the brick surface was in tension and with transverse courses (a condition which applies near transverse joints or cracks), a very low modulus of rupture was noted. Although this fact would seem to indicate an element of weakness, yet the number of tests made was so low that the tests could hardly be considered conclusive. The Illinois department has assumed that, in the light of our present knowledge, it is reasonable to consider the combined concrete and brick slab to be equivalent, from a flexural standpoint, to a homogeneous concrete slab having the same quality of concrete. Under this assumption a monolithic brick road may be considered in exactly the same class as a concrete road, in so far as traffic-supporting capacity is concerned.

Since the transverse strength of a concrete slab is measured by the modulus of rupture of the concrete, it is evident that, under the above assumption, a monolithic brick pavement should have a base of the same quality of concrete as would be used in a homogeneous concrete slab of equal thickness, in order to have equivalent strength. It is also evident that, if we should make the total thickness of a brick road 8 in. and use a lean mixture in the base, its traffic-supporting capacity would be reduced in proportion to the modulus of rupture of the base. Illinois has, therefore, adopted as one standard a 3-in. brick laid on a concrete base 5 in. thick, and having the proportions 1:2:3½.

This will result in a pavement having practically the same carrying capacity as the standard concrete pavement heretofore described. The problem is somewhat different if 4-in. brick are used, because if the same total thickness is maintained the base would be so thin as to require a finer aggregate and more care in construction. It has therefore been considered advisable to use a base of 1:2½:4 concrete, 4 in. thick at the sides and 5 in. thick at the center, making a total thickness at the center of 9 in. An examination of the table will show that this pavement should also have a load-supporting capacity equal to that of the standard concrete road.

If asphaltic or sand fillers are used instead of cement grout, it is evident that the pavement can no longer be considered to act the same as the homogeneous concrete slab. It is probable that brick surfacing with a soft filler has some strengthening effect which may be added to the carrying capacity of the base, but the amount of such effect cannot be determined definitely. In the absence of definite data, we have assumed that the strength of the combined concrete and brick slab would be equal to a homogeneous concrete slab having a thickness equal to the thickness of the base plus one-half the thickness of the brick wearing surface. For example, if 4-in. brick are used with a soft filler, the concrete is to be 2 in. less in thickness than if no surfacing were used.

Bituminous Concrete on a Concrete Base

It seems logical that the bituminous-concrete type of pavement on a concrete base should be considered in somewhat the same class as the brick with the soft fillers, so far as traffic-carrying capacity is concerned. Two designs for bituminous-concrete surfacing have been adopted by the Illinois department: (1) A 2-in. Topeka type of bituminous concrete laid directly on a concrete base; (2) A 1½-in. binder course of bituminous concrete on which is laid a 1½-in. Topeka-type wearing surface, making a total thickness of 3 in. of wearing surface on a concrete base.

Since it is wholly a matter of opinion as to how much weight can be given to the transverse strength and

and cushioning effect of the bituminous wearing surface, it has been decided, for the sake of simplicity, to allow the equivalent of 1 in. of concrete for both the 2-in. and 3-in. wearing surface. This means that a 2-in. Topeka-type wearing surface should be laid on a 7-in. concrete base, if a proportion of 1:2:3½ is used; on a 9-in. base if a 1:3:5 mix is used, or on a 10-in. base if a 1:3:6 mix is used. (See the table.)

A study of cost, taking into consideration the ordinary range in cost of delivered materials, indicates that this type of pavement will be cheaper if laid on the thinner and richer base, rather than on the thicker and leaner base. Any possible saving in cement is more than offset by the cost of delivering the larger volumes of aggregate.

The 7-in. base of 1:2:3½ mix has therefore been adopted.

Objections have been raised to the so-called unprecedented richness of the base for both brick and bituminous-concrete surfaces. The chief reasons for these objections are undoubtedly the prevailing idea that the selection of type will be dependent upon cost, and because leaner bases of about the same thickness have given reasonable service in city streets. Bituminous concrete on a concrete base has seldom been used for rural roads, and the conditions of traffic are so different that previous experience in city streets should not receive undue weight. Practically all types of properly constructed pavement have been a success or failure in city streets, dependent upon the character of traffic on the particular street. Again, all city streets are more or less satisfactorily drained by a sewerage system, whereas on country roads an equally uniform subgrade cannot be obtained at reasonable cost.

A careful analysis of the country road problem indicates that in the future there will be unprecedented conditions to meet. Heavy motor-truck traffic will prevail on all the main improved roads, and this traffic will be confined day after day to the same wheel tracks, because of the limited widths of pavement which can be built with available funds. With these considerations in mind, it seems absolutely justifiable to take this rather drastic stand in the design of pavements for a comprehensive system of roads.

Starting with one well established design of rigid pavement, it is not only feasible but sound engineering practice to design all other principal types of rigid pavement in such manner that, within reasonable limits, each will have the same carrying capacity or transverse strength, under equal subgrade and traffic conditions.

New Classification Proposed for Rock To Be Excavated

Geologist Bases Grading Rules on Ease of Excavation and True Geological Composition

ROCK classification, as used by engineers in excavation work, is not as accurate as a geologist would wish, nor does it serve to prevent many disputes in actual practice. With a view to providing a classification which will better serve, Warren D. Smith, professor of geology at the University of Oregon, has recently submitted to *Economic Geology* for March-April, 1919, the following discussion, which he hopes will receive the consideration of engineers:

The classification of rocks given in geology handbooks is too technical and too clumsy, as now arranged, for the use of the field engineer, and we find in the literature nothing very adequate which the engineer can use. In some cases he has fallen back on a classification something like this, which all geologists will recognize as being a very loose and unsatisfactory classification. For instance, I found the following classification in use by the engineers of a railroad company in Oregon: (1) Solid rock; (2) sandstone; (3) cement; (4) shale; (5) earth.

Now, all geologists know that there are many different kinds of solid rocks and many different kinds of sandstones, and so on. No regard is paid in this classification to the differences in cementing materials in the sandstones; there is nothing in here about structure, or texture, which determine the ease or difficulty in excavating the material. No attention is paid to whether the material is weathered or to the degree of alteration. For instance, the word cement may include many different kinds of cementing substances, silica, calcium carbonate or iron oxide, and it makes a great difference which one of these is the binding substance.

A good classification will probably have to include terms generally used by geologists, but these must be so grouped that we get in any one group materials which can be excavated with about the same degree of ease or difficulty, as the case may be. In the following proposed classification very heterogeneous substances are grouped together, but, taking into consideration texture, structure and composition, we think there are included those materials which, from our experience, we judge ought to be classed together for similar rating in regard to excavation.

We realize that this classification is open to criticism, but criticism is what is invited, for an excellent way to develop a good classification is to propose one, have it criticized, and then make a new one, or, if necessary, several new ones.

In the case of a small job, involving little financial outlay, where not very much can be either made or lost by the contractor, the old, loose classification as now used might be retained; but with a big piece of work, where thousands of cubic yards of rock have to be moved, it will pay both the company and the contractor to have a geologist. If the company retains no geologist on its staff then let it secure the temporary services of one, and have him classify the material to be excavated. In this particular case I know that several hundred dollars could have been saved.

For use in connection with this classification we think that Pirsson's "Rocks and Rock Minerals," with the tables there included for rock determination, should be used. There is no escaping the fact that the engineer must know the common rocks and minerals. If he does not know them now, he must either take a course where he can learn these, or a geologist must be retained.

The following classification has four main groups, and is as follows:

Name	
All granitic rocks, granites, diorites, etc.	GROUP I. Solid and unweathered rocks.
Sandstones (siliceous cement)	
Quartzites and quartz masses	
Traps (basalt) porphyries and volcanic glasses	
Conglomerates and agglomerates	
Gneisses, breccias	
All rocks of Group I. badly weathered	GROUP II. Intermediate rocks.
Sandstones (lime or iron cement)	
Limestones and marbles	
Serpentines, schists, slates and argillites	
Hardpan (glacial, etc.)	
Shales	GROUP III. Soft rocks.
Rubble limestone	
Loose sandstone	
Coquina	
Marls	
Travertine	
Tuff	
Glacial till	
Silt	GROUP IV. Unconsolidated (earth)
Mud	
Sand	
Gravel	
Volcanic ash (loose)	

Tractors Reduce Service Cost at Machinery Plant

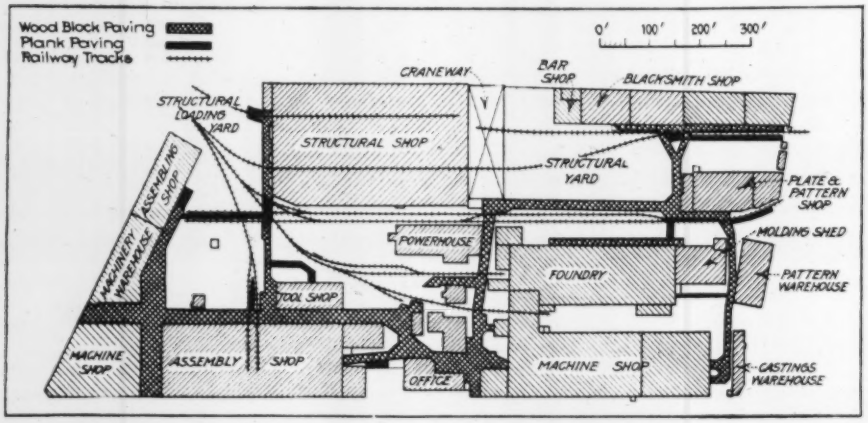
Dispatcher System with Truck Trains on Paved Roadways Handles More Material with Fewer Men Than Old Teams

NEARLY 80% reduction in cost of intershop distribution of material has been effected by the Minneapolis Steel & Machinery Co. by means of electric tractors and trucks operated on paved roadways under the control of a dispatcher system.

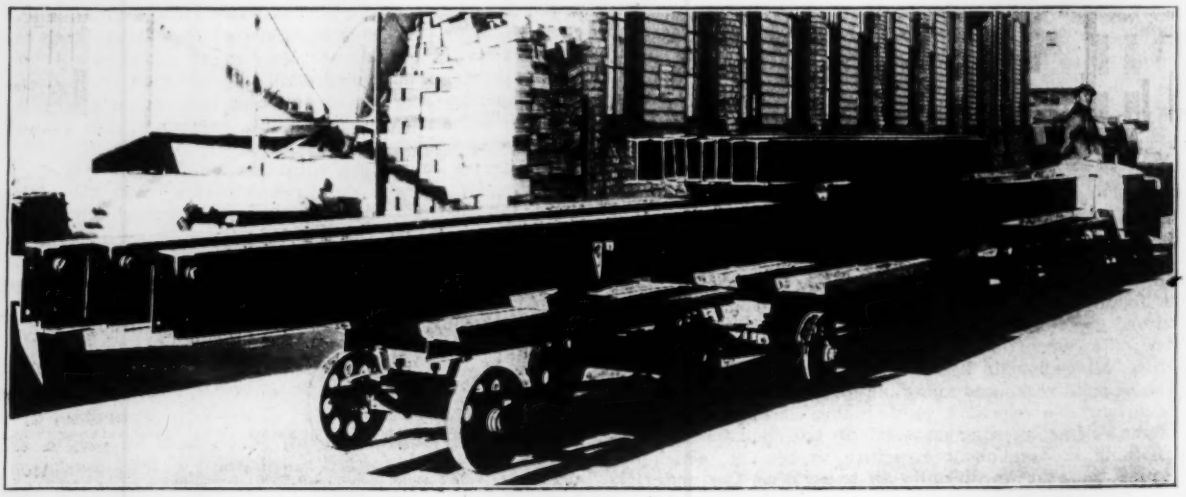
The old intershop service was operated by 14 hired wagons and teams, each with a driver and two helpers, under the direction of a foreman and four assistants, making a total of 47 men. For 100 tons moved daily the cost averaged $1.50 per ton. By paving the roadways and organizing a dispatcher system to control the movements, the cost was reduced to about $1 per ton. With the introduction of tractors hauling trains of trailer trucks, accompanied by further development of the dispatcher system, the cost was reduced to 31 to 35c. per ton for a daily business of 200 tons and with a force of 14 instead of 47 men. The average daily mileage has not been determined yet.

It is expected that by equipping the tractors with recording speedometers the charts will permit close analysis of the situation and still further reduction of the cost by 5 to 8c. per ton, through the elimination of weak points in the service. The system is similar to that at the Topeka shops of the Atchison, Topeka & Santa Fé Ry., described in *Engineering News-Record* of May 30, 1918, p. 1038. The intershop transfer system is headed by a superintendent, who has a chief dispatcher, assistant chief dispatcher, five sectional dispatchers, four tractor operators, one truck driver and one helper, a total of 14 men. There are three electric tractors, 53 trailers, one electric lifting truck and one motor truck with trailer.

All movements of material are recorded by the chief dispatcher, while his assistant looks after the field or outdoor service. The sectional dispatchers are in charge of five designated portions of the plant and see that all incoming material is delivered promptly to the departments in their respective sections, and that finished material is removed promptly and dispatched to its destination. With each movement there is a delivery slip showing the weight, pattern number, description, order number, by whom shipped and to whom and to which department the material is shipped. One copy is kept by the shipper, while the receiver keeps the second copy and signs the third copy, which is returned to the shipper. The last named in turn sends the original slip to the chief dispatcher. From these slips a record is made at the end of each day, showing the material moved and the operating cost. Material is now handled more rapidly, while delays and losses in transit, formerly encountered, are eliminated.

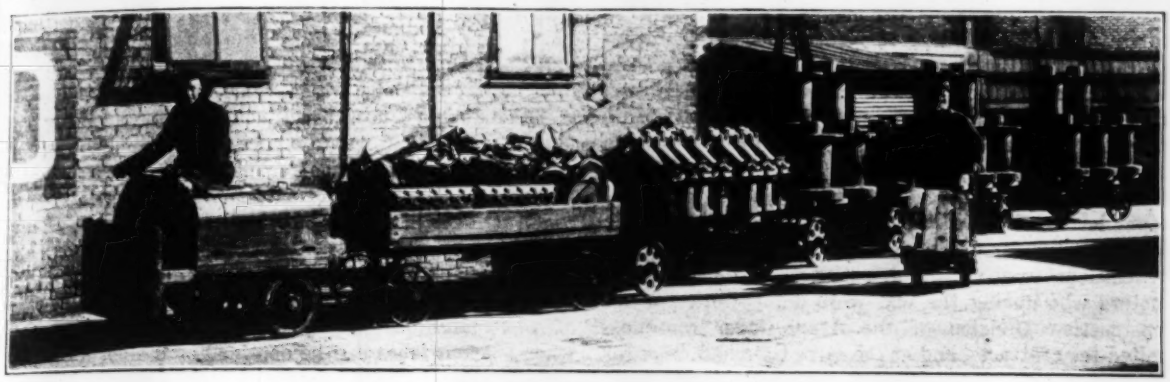


PAVED ROADWAYS FACILITATE DISTRIBUTION OF MATERIALS BY TRACTORS



TRACTOR-TRAILER TRAIN HANDLES STRUCTURAL STEEL AT MACHINERY PLANT

Creosoted-block paving is used for the greater part of the paved roadways, which aggregate about a mile in length. The balance is of 3-in. plank. The width is from 16 to 27 ft. for the block-paved portion and 5



MACHINERY SUPPLIES HAULED BY TRACTOR-TRAILER TRAIN

to 10 ft. for the plank paving. The only concrete paving is that inside the buildings. Two electric tractors weigh about 2400 lb. each and have a hauling capacity of 8 to 15 tons. The third tractor weighs about 2275 lb. and hauls from 6 to 12 tons. The plant investment of $30,200 includes $17,000 for paving, $9100 for trucks and $4100 for trailers. The only overhead figured in the cost is that which is sufficient for the operation of the trucks to cover repairs, renewals and depreciation, as the whole interplant delivery system is an overhead on productive labor at the plant. No comparison can be made between the present investment cost and that under the old system, as the company did not own the teams formerly used.

The new system was devised and developed by George H. Anson, superintendent of the intershop transfer and warehousing department, and James B. Gilman, chief engineer of the company.

Low Labor Output in War Work Not Due to Cost-Plus Contract

Interviews With Contractors Prominent in War Work Indicate Low Efficiency of Labor Resulted From Long Hours and Excessive Demand

(*Editorial Interview*)

WAR construction was extravagant in the expenditure of labor. Workmen of all classes were inefficient. Did the cost-plus contract encourage this inefficiency? The word is being passed among construction men that it did. It is being repeated that cost-plus contracting reduced the productiveness of labor and did away with the incentive for close management. A sentiment which was keen for the extension of cost-plus methods is therefore growing indifferent and to some extent turning reactionary.

Inquiry made of a contractor who ranks high because of his successful work of many years, and who carried out important war contracts, elicited the astonishing response that cost-plus contracting was unqualifiedly detrimental to efficiency in construction. The question was then divided into two:

"Is it your experience that labor is less efficient in cost-plus construction?

The answer was "Yes."

"Is the fact due to the form of contract or to some other cause?" was then asked.

The reply was, "The cost-plus contract takes away the incentive to good work and good management."

Merely as personal opinions, these statements were impressive because of their source. They prompted the extension of the inquiry. Interviews were obtained from six contractors, of large experience in peace-time construction, who had been prominent in war work. All freely admitted that the output of labor had been below normal in war construction. All strenuously denied that cost-plus contracting was the cause. Responsibility was placed on overtime work, long hours, scarcity of labor, unwise publicity and the disposition of labor to profiteer. Promise of anonymous publication elicited candid expressions of opinion, on various features of cost-plus contracting, which are deserving of the most serious consideration by contractors who are uncertain of their attitude toward the movement to extend the practice to public-works construction generally.

Causes Affecting Efficiency—Indulgence in excessive overtime was a prolific cause of inefficiency of labor in war construction. It reduced the output of the workman and it lowered his morale and excited his greed for "big money." Undoubtedly, knowledge that overtime must be employed decreased in many instances the output of the workman during straight-time hours. This, coupled with the anticipated and realized decrease of 25 to 50% in efficiency in the overtime hours, amounted to a serious reduction in output per man per hour. Also without doubt, the emergency of war warranted the employment of overtime work even at the sacrifice indicated, but its detrimental results should not be held to be a normal effect of cost-plus contracting.

In much war construction the management worked long hours under great pressure. Opinion differs as to effects. Some assert that supervision was just as efficient and painstaking as it is under normal conditions. Others assert that superintendence and foremanship were less keen; long hours depleted the energy of the men, and the constant demand for quick decision prevented the consideration which some questions needed for wise decision. The success of cost-plus contracting hinges very largely upon the spirit imparted to workmen through their executive superiors. With its energy sapped by long hours, supervision was less inspiring. A portion of labor's inefficiency was traceable to this cause.

Scarcity of labor, and constant newspaper publication of the fact that contractors were borrowing, begging

and even stealing workmen wherever they could be found, gave labor a feeling of independence which often expressed itself in "loafing on the job." Independence was further increased by a weekly wage greater than many workmen required to meet their normal living expenses. The effect of this unusual affluence was in some cases to encourage dissipation and a disposition to lay off, while in other cases it aroused a greed for accumulation which led the men to dole out their energy so that credits for overtime would mount up.

Inefficiency was not peculiar to cost-plus work. Contractors who during the war were doing work for the Construction Division of the Army under cost-plus-limited-fee contracts, and at the same time had work for private concerns on a unit-price basis, were unable to see that there was any greater inefficiency in one case than in the other. Labor was very inefficient in both cases.

War Results Not Criteria—There is no reason to believe that conditions which contributed to inefficiency of labor during the war will continue a controlling influence after the war and particularly after the lapse of a period of readjustment in living standards. The labor market will approach normal conditions, and haste in construction will cease to be the supreme requirement. As stated by one contractor, "It would be manifestly unfair to consider the cost of emergency war contracts or the efficiency of labor on these contracts as a criterion of what might ordinarily be expected in peace work when efficient labor can be obtained or a laborer who is not efficient can be replaced by one who is."

C. S. H.

Poor Plumbing and Unruly Temper Cause Institutional Water Waste

HIGH consumption of water at the Illinois State Reformatory is attributed largely to poor plumbing and the unruly character of the inmates, according to a recent report made to F. J. Postel, supervising engineer of the State Department of Public Works and Buildings by H. G. Thomas, assistant engineer, following an exhaustive water-waste survey.

No underground leakage from the mains was found that would register on a ¾- or 1-in. meter. Meters were then installed on leads to the various buildings or groups of buildings, seven in all. In the past three years the consumption has varied from 91 to 235 gal. per capita. The average since February, 1916, has been 170 gallons.

Quoting Mr. Thomas: "I attribute this solely to the condition of the plumbing and the temper of the inmates. The north cell-house is the older, and the cocks on the cell fixtures are of poorer construction than in the south cell-house. Incoming inmates are also first assigned to the north cell-house as well as all third grade or most unruly inmates.

"The cocks being of poorer construction, are more easily put out of commission, and the per capita consumption in the north cell-house runs about 140 gal.. as against 72 gal. in the south cell-house. Most of the inmates are in the shops or on the farm or grounds for about eight hours of the day, and wash up for their noon and night meals in the shops and make use of the shop fixtures for toilet purposes during that period."

Some of the groups gave the following daily per capita rates: Chain shops, store, machine shop, blacksmith shop, carpenter shops, foundry, print shop, inside barn, south cell-house, bathroom, south towers and all of the farm, 30 gal.; superintendent's houses and offices, 99 gal.; north cell-house, 140 gal.; school, receiving and discharging department, tailor, shoe and paint shops, yard gang, toilets and showers, captain's office, library and most of the offices and inmates' kitchen demand, 10 gal. per capita of the whole population; peeling room of inmates' kitchen, officers' quarters, and bakery, 4 gal.; south cell-house, 72 gallons.

A favorite habit of the inmates is to balance the self-closing cocks open so as to wash in running water. Temporary relief is being tried by putting on a stop to prevent opening the valve wide. It is estimated that all the present outlet cocks in the cells can be replaced by positive self-closing cocks at a cost of $4800 and reduce the use of water to 40 or 50 gal. per capita, also largely reducing the annual water bill.

Education for Intelligent Industrial Production

Addressing a body of students and professors at the State University of Iowa recently, Prof. J. H. Dunlap stated that the primary purpose of all education in applied science was more intelligent industrial production.

The state is furnishing educational facilities to the end that there may be in this country and in the world trained engineers who will make a return of a thousandfold in terms of intelligence. He said that the two fundamental elements of production are materials and men, yet the engineering school of the past has been largely concerned with materials, their physical properties and the laws by which they can be utilized in the service of mankind. The second factor of production—namely, the human factor—cannot be neglected longer.

The war has brought mankind to the firm determination that the square deal shall be given it, or else no deal at all. The world today is divided into two camps. One camp is seeking the upbuilding of mankind through the destruction, root and branch, of our capitalistic society. The other camp is seeking the upbuilding of mankind through the beneficent operation of an applied science which will make surveys, determine causes, design and build in human society an immortal structure which shall be forever founded on those elementary principles of justice to all men, for which we have been fighting in time of war, and for which we must continue to struggle in time of peace. The problem, in its final analysis, is an engineering problem.

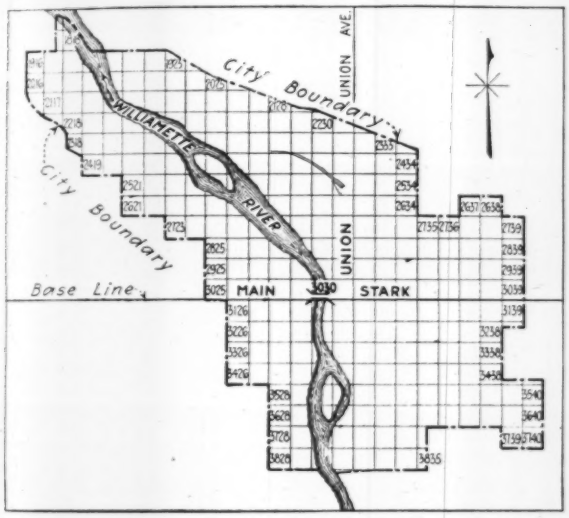
Its solution rests with men trained in methods of scientific investigation and in the application of law to every problem of life. Such men are to be the engineers of the future, the builders of a new world.

Reference Maps More Accessible With New Numbering

Quarter Section Sheets of City Map of Portland Oregon, Numbered with Reference to Base Line and Meridian

By Orrin E. Stanley
Sewer Engineer, Portland, Ore.

PORTLAND has recently substituted a logical system of numbering the "quarter-section sheets" used as reference maps in the city offices, in place of the old and cumbersome manner of designating them, which apparently "just happened." By the new system, the city is divided into half-mile zones extending east and west, and the half-mile squares in these zones are numbered consecutively from west to east, a hundred numbers being assigned to each zone. The zones themselves are



NUMBERING ARRANGED IN ZONES WITH REFERENCE TO A MERIDIAN AND BASE LINE

numbered from north to south, their numbers being the first two figures of the sheet numbers, while the last two figures indicate the position of the quarter section with reference to a meridian.

By the old, discarded method a map of the city was divided into half-mile squares. Those of the top row were numbered from west to east, beginning with No. 6; the second row started at the east with No. 7; while the third row began at the west with 15, each row ending at the city boundary. In this manner sheet No. 172 was reached at the south edge of the city. Additional territory was annexed to the city from time to time, and the sheets showing these annexations received consecutive numbers, from 173 to 244, these higher numbers appearing at most unexpected places around the edge of the guide map. No copy of a law limiting the numbers used for this purpose to 244 can be found, but for some reason (or lack of reason) the use of figures stopped there, and additional sheets were designated by letters. The entire alphabet was used for this purpose, and by means of primes was used as far as T" a second time through. Fortunately, the expedient of using Greek or Chinese characters does not seem to have occurred to the draftsman.

These sheets are arranged by consecutive numbers in book form for use in the various offices, and under the old arrangement much annoyance was experienced in trying to follow a street beyond the limits of one sheet. Several draftsmen in the city engineer's office felt that a reform was desirable and set about bringing order from chaos by giving the sheets numbers from which their relative position in the city might be readily determined.

The first plan suggested was to have 50 zones of 50 squares each; another proposed zones of 40 numbers each, a third plan called for the use of letters to designate the zones and numbers of one or two figures to indicate the position of the sheets with reference to a meridian. Each of these plans was fully discussed in the drafting room and finally got to the city engineer, but they were all rejected in favor of "hundred-number" zones.

For purposes of computing the haul of heavy materials such as sand, gravel, etc., the "official" center of the city is assumed to be the center of the drawspan of the Burnside St. bridge. The quarter-section sheet which shows this point near its center received the number 3030. This allows for the growth of the city to a point 15 miles to the north and the same distance to the west of this place without getting beyond the limits of the numbering scheme, and it was thought by those who discussed the matter that topographical conditions are such that a greater extension of the city in those directions is very improbable. The arrangement of numbering is shown on the accompanying map, with the intermediate numbers omitted. Sheets having 30 as the first two figures lie along the north side of the Willamette base line, and those having 30 for the last two figures lie along the west side of Union Avenue.

The entire city is mapped on these quarter-section sheets, the original scale being 100 ft. to 1 in. Blueprints or white prints on cloth are used in many of the city offices, and additional information—such as the location of houses, the house-numbering outline, the sewer system showing house branches, the water system with all connections, survey monuments with corrected measurements between them, street-grade elevations, curb distances, etc.—is drawn on them for use in the offices where such information is desirable.

Rectograph prints of the tracings, reduced to a smaller scale, are used in several of the offices where only such information as is shown on the original tracings is required.

This numbering scheme was worked out in the city engineer's drafting room some time ago by L. F. Schuele and the writer, but it was not made effective until the present city engineer, O. Laurgaard, ordered the necessary changes made on the drawings.

Engineers' Registration Act for Oregon Amended

The engineers' registration act for Oregon, discussed in *Engineering News-Record* of Mar. 27, 1919, p. 616, has been amended to include the insertion of a sentence which makes the Board of Engineering Examiners consist of two civil engineers, two mechanical engineers, one electrical engineer, two hydraulic engineers and two mining engineers.

Reinforcement of Bridge by Means of an Eccentric Chord

Floor Span Over Railway Tracks Weakened by Corrosion — War Conditions Delay Renewal — Erection Conditions Necessitate Placing New Chord Above Floor—Panels Offset to Balance Eccentricity

A DIFFICULT problem was presented recently by the necessity of strengthening a steel bridge span in Chicago without infringing on the underclearance and without using falsework. It was solved by the ingenious expedient of adding a second bottom chord above the floor of the bridge, and, as this chord was far off center of the web connections, neutralizing the eccentricity moments at the connections by irregular alignment of the chord. At the same time the floor of the bridge was strengthened in effective manner by placing new hangers and by supplementing the steel stringers by wooden stringers.

FIG. 1. SPAN OF TWELFTH STREET VIADUCT, CHICAGO, REINFORCED BY ADDING BOTTOM CHORDS ABOVE THE FLOOR

Twelfth St. crosses a group of important railway tracks by a viaduct 810 ft. long, composed chiefly of wrought-iron truss spans, built in 1886. In the course of time corrosion had destroyed large parts of the floor and bottom chord members exposed below the floor, and within the past four or five years replacement or repair had become an urgent matter. Designs for a larger and more substantial viaduct were prepared three years ago, and the expectation was that construction could be undertaken in 1917 or 1918. The state of the steel market, however, made it impossible to obtain material, and the work was postponed indefinitely.

On account of the great importance of the crossing with respect to street traffic, some method of reconstruction had to be devised to keep the structure in service, and the plan had to be such that the work could be done under traffic. Twelfth St. is the only thoroughfare across the tracks in a distance north and south of nearly a mile. It carries important vehicle traffic and a street-car line, so that closing the street during the repairs could not be considered. The railway traffic is equally important, and could not be interrupted.

The chief difficulty was presented by a through-truss span of 110 ft. 9 in., crossing a group of New York Central R.R. and Rock Island R.R. tracks, including the four main tracks of the New York Central R.R. The span has three trusses, the middle one separating eastbound and westbound roadways. The underclearance here is only 17 ft., so that no space was available for either staging or supports under the bridge. On account of the low clearance the blast action of the engine exhaust had been of particularly severe effect. The stringers and bottom chord for the entire length except the panel at either end were seriously weakened; the bottom chord, for example, had been reduced in section nearly one-half. Furthermore, some of the bars of the pin-connected lateral system had been cut in two. Corrosion had also been active, and the top flanges of the stringers were materially reduced in section. It was necessary to replace all these parts entire. The floor-beams, on the other hand, had not suffered greatly. In these circumstances the main problem was how to replace the bottom chord under the hampering space and traffic conditions. Replacement of the stringers offered less difficulty.

It was decided to leave the old bottom chord undisturbed and add a new chord just above the floor, 30 in. above the old one, carrying it down in the end panels to connect centrally at the end pins. As the web members intersect on the center line of the old chord they would be several feet apart at the level of the new chord, and thereby would develop very large rotational moments. To neutralize these moments the chord was offset in successive panels, as shown in the diagram elevation, Fig. 2.

Below the truss diagram in Fig. 2 is given the graphical stress polygon for full live load, from which it will be seen that the chord and web stresses are in equilibrium under this load condition. The inclination of the short chord sections between adjacent web members was worked out by analytical computation to produce this result, and the stress polygon is merely a check. The rotational tendency of the web stresses at each eccentric panel point is just balanced by the opposite rotational tendency of the tensile stresses in the bottom chord.

As detailed, the short sections of chord at the panel points are formed by large gusset plates, which make

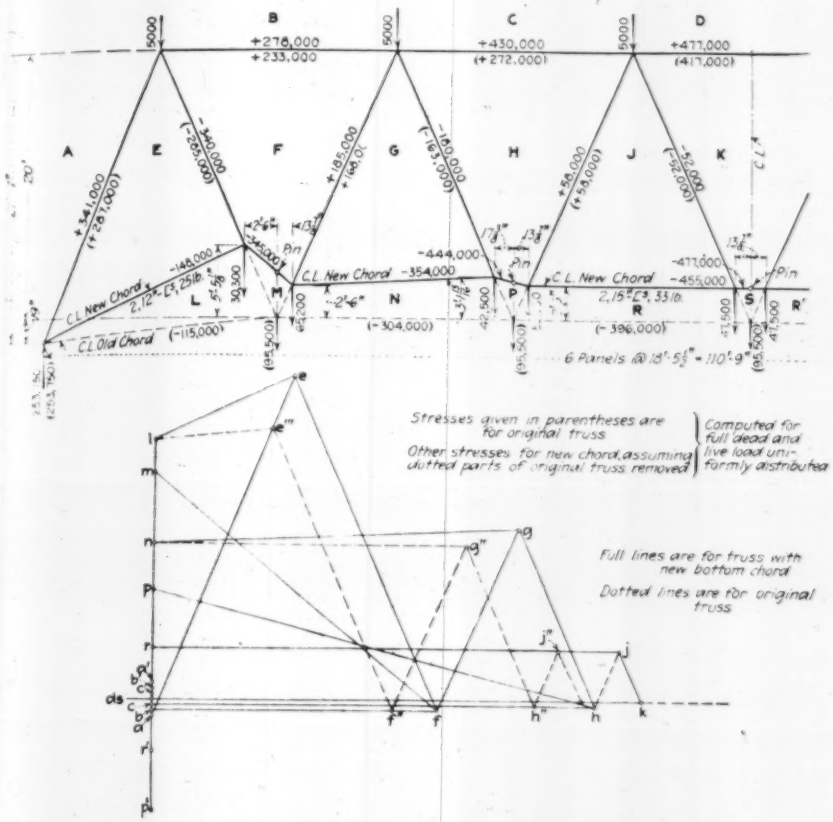

Stresses given in parentheses are for original truss
Other stresses for new chord, assuming dotted parts of original truss removed
Computed for full dead and live load uniformly distributed
Full lines are for truss with new bottom chord
Dotted lines are for original truss
C.L. New Chord
C.L. Old Chord
6 Panels @ 18'-5½" = 110'-9"

FIG. 2. TRUSS DIAGRAM AND FORCE POLYGON FOR REINFORCED TRUSS—CHORD ALIGNED SO AS TO NEUTRALIZE ECCENTRICITY MOMENT

the connection between the new chord and the old web members. The panel point, therefore, is a stiff assemblage, and the secondary stress moment occurring under partial live load are distributed equally to the members, without strain in the connection.

As the truss with the new chord (considering the old chord out of action) is shallower than before, the primary stresses in most of the truss members have been increased about 10% by the change; but as these members are in good condition the extra stress is not of serious consequence.

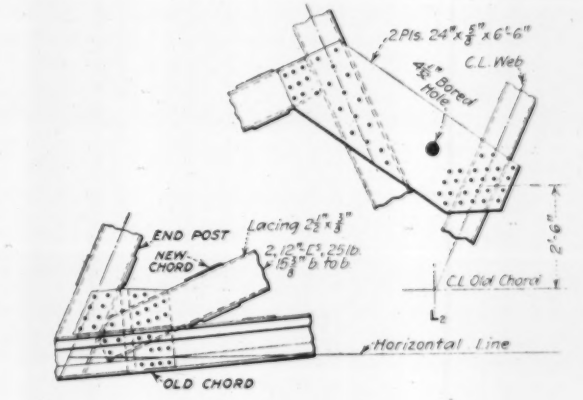
In strengthening the floor the main item was placing 9 x 18 timber stringers between adjacent steel stringers. The timbers were designed to carry the full floor load without assistance from the old stringers. A special stirrup support was designed for carrying them, consisting of two 3 x ½-in. steel bars passing over oak saddles on top of the floor-beam and engaging anchorage angles under the new and old stringers, all as shown by a detail in Fig. 4, which is shown on the following page.

At each truss panel point the gusset plates of the new chord carry a 4-in. pin on which are hung two U-rods (Fig. 4). The lower threaded ends of these rods carry bearing plates on which the old floor-beams are seated; stiffener angles riveted to the ends of the beams engage the rods in such a way as to prevent lateral movement.

In carrying out the work, the first step was to reinforce one of the outer trusses, street traffic being diverted to the other roadway to give working room. The reinforcement of the other outer truss was the second step. The middle truss then had to be reinforced while both roadways were in service. Throughout the whole operation the street-car service on both roadways was maintained.

With the trusses reinforced, it was an easy matter to place the floor-beam hangers, then the new timber stringers and their stirrup connections. This work was done first on one roadway, then on the other, vehicle traffic being diverted to a single roadway. The weakened or severed bottom laterals were not replaced, as the structure was believed to be stiff enough to require no lateral system.

Under the contract with the city, requiring that repairs to the viaduct be made by the railway whose tracks are crossed, the work was paid for by the New York Central Lines West and the Rock Island Lines, at a total cost of about $11,000. The planning and execution of the work, however, were in the hands of the New York Central R.R. B. R. Leffler, bridge engineer, New York Central R.R. West of Buffalo, worked out the scheme of reinforcement, and decided upon the use of a secondary chord. The idea of offsetting



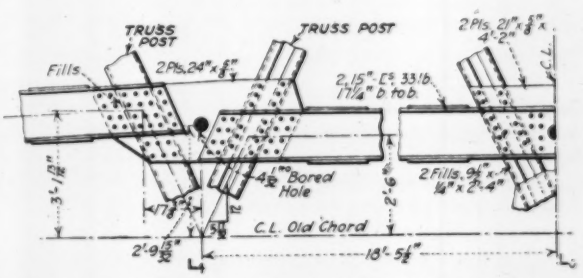


FIG. 3. DETAILS OF NEW BOTTOM CHORD FOR TRUSS REINFORCEMENT

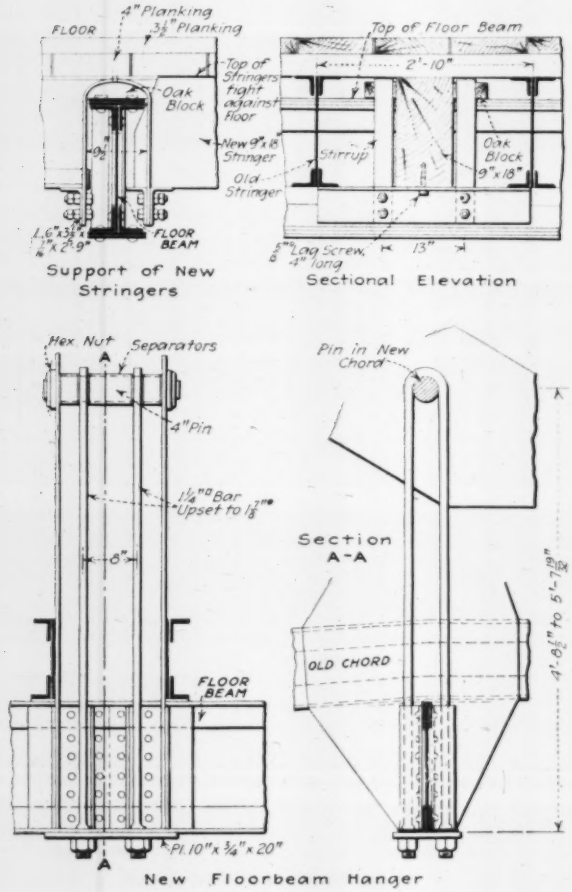


FIG. 4. FLOOR-BEAM HANGER AND STRINGER STIRRUP

the chord in such a way as to neutralize the rotational moments at the joints was developed by H. Grytness, chief draftsman in Mr. Leffler's office. The reinforcement work was carried out by the Strobel Steel Construction Company, of Chicago, on a force-account basis.

Patch Worn Paving with Concrete

Concrete patching for cuts and wornout places in brick, asphalt, concrete and other paving is being used extensively at Terre Haute, Ind. It was adopted on account of low cost, and is said to be entirely satisfactory.

The worn spot of the pavement is first cleaned out to the base of the original pavement, all dirt being removed, and then a thin layer of cement grout is sprinkled on and worked with a brush or broom till it covers the bottom and sides of the hole, which is then filled with concrete.

The most important part of the operation, according to John W. White, secretary of the board of public works, is to have proper concrete. This should be a 1:2:3 mix, using washed material with coarse aggregate ranging from ¼ to ¾ in. The surface is finished with a wood float ½ in. above grade to allow for shrinkage in setting, and traffic is kept off for several days. Large and small patches are made, there being no limit as to size.

Drainage System for Improved Country Highways

Tile Underdrainage Would Protect the Surface, Decrease the Cost of Roadside Maintenance, and Remove Dangerous Ditches

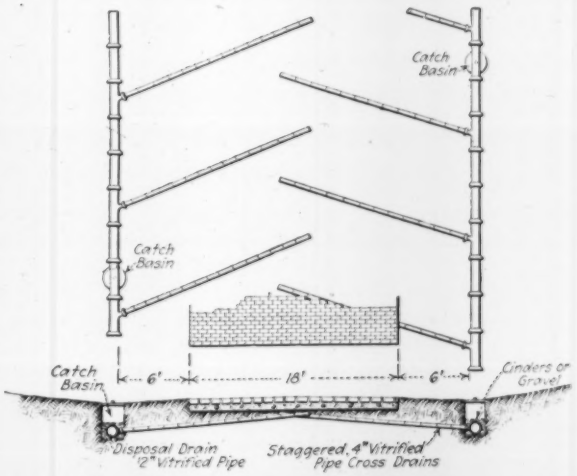
By Will P. Blair
Vice-President, National Paving Brick Manufacturers' Association, Cleveland, Ohio

ADEQUATE drainage systems consisting of tile underdrain should supplant the obsolete ditch for improved country highways. If this were done the road would not only be better drained, but, by the elimination of the unevenness of the right-of-way, keeping it in good condition would be easier, thus saving a large portion of the expense of roadside maintenance, which often costs more than maintenance of the wearing surface. Aside from protection of the wearing course by more effective drainage and greater economy in maintenance, the danger from deep side ditches would be removed—to the great advantage of traffic.

The need for proper drainage continually confronts the engineer when designing and planning a road improvement, but it is as constantly ignored. In fact, drainage neglect is so common a fault that the most illuminating examples fail to impress deeply. We have echoed and preached in meetings and at conferences its necessity. Reference to the subject so often made has put it into a trite class, so that its consideration has merely followed a rut, rather than receiving any really constructive treatment. It has not been made the subject of research or experiment, or of serious thought.

The most common road-drainage design is to provide open gutters or ditches at the roadside. City streets are seldom underdrained at all. The practice has scarcely been called in question. Water-disposal pipes are frequently placed underneath and lengthwise of the roadbed, resulting in injury to the road. The use of open side ditches may almost be regarded as a universal practice. For what reason? They do not drain.

Can the function intended be provided for by a different plan? I believe so. Not that it might be universally employed, but always wherever other means are less efficient. The plan is shown by the sketch diagram and cross-section. The side disposal drains are



SIDE DRAINS WITH STAGGERED CROSS DRAINS REPLACE DEEP SIDE DITCHES

placed below the frost line where water can flow continuously, unhindered by either ice or dirt accumulation. The side drains should also be placed at such depth that the lateral drains will receive sufficient fall, so that the subgrade can be freed promptly from excessive moisture, thus insuring against damage by heaving due to freezing. Where the road surface is impervious an entirely dry base can be maintained. The entire right-of-way can be graded, providing only for a gentle flow of the surface water into occasional catchbasins located at proper intervals. The sides can then be mowed and cleaned at the least possible expense.

Comparing this condition with the open ditches, the latter require constant attention to keep them from clogging up and retarding the flow of water. Instead of real drainage, we usually have a system of frog ponds—reservoirs which feed the moisture by capillary attraction into the roadbed—resulting in more or less but constant injury to and ofttimes destruction of the wearing surface.

While the fact that the cost of maintaining the berms and embankments imposed by the open ditches is often greater than the cost of maintaining the wearing surface has been perfectly apparent to experienced observers, actual data have but recently become available for its confirmation.

In Illinois, 59 miles of improved brick road surface cost $5.36 per mile to maintain. The shoulders of the same road cost $51.20 per mile. Maintaining the surface of other roads was found to cost $30.25 per mile, while their shoulders cost $51.20 per mile.

In Ohio, 302 miles of brick road surface cost $10,351.99 to maintain. The roadsides of the same mileage cost $27,183.53. Other road surfaces covering 381 miles cost $39,825.17 and the roadsides cost $52,522.78.

Underground Drains Easy to Maintain

It is known from experience that underground disposal drains are maintained in constant working order with scarcely any cost whatever for an indefinite number of years. The cost of installation in many instances is less than that of the open ditch. Cost of drainage is often made the reason against its installation, yet a single case, to which Fred R. Williams, paving engineer, of Cleveland, will bear testimony, demonstrates the unsoundness of the excuse.

The case in point came about in the construction of Woodhill Road in Cleveland. The specifications provided the drainage plan herein advocated. In spite of frequent rains, the installation of the drainage system enabled the contractor to proceed with his work of laying the pavement. Other street contracts held by the same contractor, but not calling for such drainage, were held up, awaiting a sun-dried condition. The lesson of economy was so plain that the contractor, without other compensation than that of being able to proceed with his work, installed this very system as a matter of construction economy.

Aside from the economy in construction, durability of the road and the great reduction in maintenance cost due to establishing a drainage system that will drain, we must be alert to the fact that open ditches on the roadside are often a menace to life. In case of fatal accidents there is but little difference in results whether your team or auto goes into the ditch, down the mountainside or over a precipice.

But a greater reason than all else in support of drainage which will drain is the increased durability which it adds to the life of the pavement, thereby lessening maintenance cost and increasing efficiency and satisfaction in use.

Kentucky Sump Holes Materially Reduce Flood Flows

By R. W. Spear

Chicago

UNDERGROUND conditions in Kentucky on the site of the water-supply for Camp Henry Knox, a field-artillery firing center located at Stithton, are such that the flood flows are as much as 40% less than the calculated maximum. This is due to sump hole areas, common in Kentucky, which are connected with caverns in the soluble limestone and afford temporary storage.

Otter Creek empties into the Ohio River about 30 miles downstream from Louisville. The drainage area above a proposed dam is 150 square miles. From 25 to 50% of this area is composed of sump holes, which are so deep that even in prolonged rainy seasons they have no surface outlet. The location of the outlets is generally unknown; but the writer learned during the course of his study that a particular sump hole was the source of Big Springs, outside the Otter Creek drainage basin about five miles from the sump hole. This fact was established in a crude but efficient way by farmers who poured corn cobs in the sump hole and later observed them coming out at the Big Springs.

It is probable that some water is carried into and some outside of the drainage basin, through these channels. By comparing the Otter Creek watershed with others having similar shapes and sizes and having approximately the same character of rainstorms both in intensity and duration, it was found that the probable maximum run-off at the dam would be 19,000 cu.ft. per second. By calculations made from high-water marks, a maximum flood of 11,000 cu.ft. per second was obtained.

Reason for Discrepancy

In the writer's opinion, the entire discrepancy in the above figures cannot be attributed to the mere possibility that more water is carried out of than into the watershed by the outlet of the various sump holes. The major portion of this discrepancy must be attributed to the fact that a very considerable portion of the total rainfall finally reaches the channels of Otter Creek and its feeders through the sump-hole channels—a route that is much slower than the surface drainage routes. The distance from sump hole to creek is often as much as five miles, and the water in passing through the underground channel has such a sluggish flow that the sump holes empty themselves only at a considerable period of time after the cessation of a storm. In many instances this underground flow is so slow that the sump holes become ponds.

Geologically, a sump hole is a tumbled-in cavern formed originally in a porous stratum near the surface. These sump holes and caves hold back that portion of the storm water which would contribute to the peak load stream flow, until after the surface drainage has reached the streams and passed on.

Reorganization of the Engineering Standards Committee

Effect of Engineering Standards Movement on Technical Societies—Reorganization to Give Broader Representation—Association May Be Formed to Elect the Committee—Formulating Safety Codes

By Edward B. Rosa
Chief Physicist, Bureau of Standards, Washington, D. C.

(Concluded from "Engineering News-Record" of May 1, 1919, page 862)

Opening to discussion the vitally important subject of centralized standardization, the first part of Dr. Rosa's article asserted that existing technical societies will not be harmed, that the movement is founded on principles of fair play, and that a coördinating agency is needed in standardization. After telling why reorganization on a democratic basis became necessary, he undertook to sketch one idea of the possible ultimate form of organization. Continuing this subject, Dr. Rosa proceeds to point out why the Bureau of Standards and other Government agencies are concerned in the movement.—Editor.

DIVISION 6 would consist of the American Society for Testing Materials and a considerable number of national associations concerned with materials. The American Society for Testing Materials would be the leading society in the division, and would carry on its work substantially as now. It would be in close association with the other societies of its division, with lines of connection with other divisions through members of its coöperating committees. This division would contain representatives of many other societies besides the American Society for Testing Materials, but probably most of them would also be members of the American Society for Testing Materials. Division 6 would, in fact, be an American Society for Testing Materials family, as Division 1 would be an electrical family in which the American Institute of Electrical Engineers would naturally take the lead. Similarly, the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Mines and Metallurgy, the American Chemical Society, the Society of Automotive Engineers, the American Railroad Association and other large societies and associations would presumably take a leading position in their respective divisions. The influence of these leading societies and the recognition accorded them would be enhanced by this relation.

Scope of Activities

Most of the business of the Standards Committee would probably be done by an executive committee and the paid general secretary and assistant secretaries acting under it. The various sections of the Standards Committee would be advisers to the executive committee on matters pertaining to their respective subjects. The Standards Committee would report annually to the American Engineering Standards Association, which, as a great self-determining national body, would authorize changes of procedure, provide for the selection of the Standards Committee and approve its budget and plans. Such an organization would be businesslike and effective, and as simple as that of any large national organization. The office staff should include some competent editors and draftsmen to assist in putting standards into good form for publication, in as uniform style as possible.

It would be desirable for the association to publish all standards prepared under its supervision in a uniform edition, fully indexed, and thereby make them readily available at small expense to the general public. In connection with such publication, they would be carefully studied to see whether there were conflicts or inconsistencies among them, and useful references would be made from one code or standard to another. Such publication in uniform style, with explanatory footnotes and cross-references, would be of enormous value. It would be the greatest step ever taken toward general acceptance and national uniformity in engineering and industrial standards. This would, of course, not interfere with the publication by each society of its own work in its "Proceedings."

Budget of the Committee

The American Engineering Standards Association should have an annual income of not less than $50,000, in addition to the cost of publishing standards, which work would be self-supporting. This income would be derived from a large number of memberships in the association. These memberships would not be personal, but every member would represent some engineering or industrial organization or Government department. If one member were appointed for every 500 members of an engineering society, and a membership fee of $50 were paid, this would amount to 10c. per year per member of such society, and would not be a heavy tax for so important a matter. It would yield $1000 (with 20 members appointed to the association) from a society of 10,000 members, and would give $50,000 per year when the association had 1000 members. As yet, however, no provision has been made for a large membership, and this proposal is only a suggestion for future consideration.

Why the Bureau of Standards Is Interested

The Bureau of Standards has been greatly interested in the plans of the Engineering Standards Committee from the start, and hoped to see them realized at an early date. The reasons for this were, first, that the committee would be able to render a service of tremendous importance in promoting engineering and industrial standardization, and, second, that it would aid the bureau in getting into closer contact with engineering and industrial organizations and secure a better understanding of the bureau's work. It is impossible for the bureau to explain its work and its plans in detail to every agency that is interested. Although bureau representatives do a large amount of traveling and participate in a large number of conferences and committee meetings, and although the bureau has a large number

of coöperating committees assisting in its work, it is beyond its power to consult everyone who thinks he ought to be consulted in advance of taking up work, or to communicate results from time to time to everyone interested.

We have earnestly wished for years that there was some agency or mechanism that would provide a better connection than has existed between the bureau's research and standardization work and that of the engineering societies and industrial organizations. It appeared that the Engineering Standards Committee, especially if reorganized as proposed so as to be democractic and thoroughly representative and supported by a strong public sentiment, afforded an ideal method of coöperation between the agencies of Federal, state and municipal Government and the technical and commercial organizations concerned with engineering and industrial standards.

Neither the Bureau of Standards nor any other Government department was concerned in the organization of the Engineering Standards Committee, except that the bureau was consulted occasionally, and promised its support when the proper time should come. The bureau has recently been drawn into the discussion in connection with the proposed reorganization of the committee, and believes that the present plans are wisely drawn and deserve general support. The bureau offers its full coöperation in establishing and carrying on the work of the association, and invites the coöperation of the Engineering Standards Committee in return.

Why the Government Is Interested

There has not yet been opportunity for discussion by all departments of the Government of the new plans of the Engineering Standards Committee. It is easy to see, however, why the Federal Government should participate in the formation of an American Engineering Standards Association, within which there is to be an able and representative Standards Committee on which the Government departments will be represented and which will aid in securing the coöperation that is essential in the preparation of standards and specifications. The departments will, of course, be free to act independently of the committee when they see fit, just as any society may do, as there will be no compulsion exercised. But the advantages of coöperation are so great that the committee will without doubt be utilized to the full, and important and far-reaching results in the direction of better and more uniform specifications, leading to economy and simplification in buying, may be expected.

The war has taught many lessons, not the least being the feasibility and advantage of producers coöperating with and helping the Government. Another lesson is that standardization and simplification of sizes and styles are practicable, and go far in the direction of reducing costs and investment in stock. When one thinks of the immense opportunity for improvement in these respects in all the purchases by Federal, state and municipal Governments, and the equally great influence such standardization will have on business generally, it is hard to refrain from extravagant language as to the duty of the hour and the obligation resting upon those in authority to act promptly in this matter.

Some months ago the Bureau of Standards outlined a plan for the preparation of a series of national industrial safety codes. They were intended to meet the needs of a very large number of industries, and to be suitable for adoption by the state accident and industrial commissions. It was planned to secure in the preparation of these codes the active coöperation of engineering and industrial associations, manufacturers, engineers of state and municipal agencies, inspectors, etc. A large and representative committee would be formed to advise the bureau as to the general plans, and many small working committees to assist in the preparation of the various codes, of which there would be fifty or more.

A conference of representatives of all the interests concerned, to discuss the question and to advise with respect to plans for the work, assembled in Washington on Jan. 15. The bureau did not feel warranted in assuming the leadership in so large an undertaking without the strong support and promise of coöperation of the various interests concerned; and it wished to have approval in advance of its plans for securing this coöperation, if the work were to be undertaken. The bureau had frequently been requested to take it up. There was no doubt that the work ought to be done. Industrial accidents to the number of 750,000 each year (not counting the railroads and other industries outside the range of the proposed codes), including perhaps 20,000 fatalities, and millions of dollars paid annually in compensations for accidents, constituted a powerful argument for action.

The questions put to the conference were, "Should the Bureau of Standards take the lead?" and, "Should the work be done under the auspices of the recently created Engineering Standards Committee?" (which, however, was not yet functioning). This brought up the question of whether this committee was sufficiently representative to serve in such capacity, and after a discussion within the committee and between it and a limited number of representatives of other interests, which discussion has continued for three months, the committee has prepared for recommendation to the five founder societies a revision of its constitution which provides for a broadening of its membership and functions and a change of name to the American Engineering Standards Association.

A Referendum on the Question

The Washington conference of Jan. 15 appointed a committee of three (of which the chairman of the Engineering Standards Committee was one) to prepare a report of the conference to be sent to all the engineering, industrial and Governmental bodies represented and to ask for a written reply to the above questions, on which no vote was taken at the conference. This report was held up at the request of the chairman of the Engineering Standards Committee, pending the result of its discussion on the question of reorganization. It has recently been sent out, with a brief statement of the proposed plan of reorganization and a recommendation by the bureau that the work of creating industrial safety codes be carried on under the auspices of the reorganized committee.

No Conflict of Interest

The chairman of the American Engineering Standards Committee, Prof. Comfort A. Adams, now president of the American Institute of Electrical Engineers, with whom I have worked in full accord on the committee

of three, sailed a few days ago for Europe. The third member of the committee, H. W. Forster, representing at the Washington conference the National Fire Protection Association and the National Safety Council, is now in the West. It therefore seems to devolve upon me to give a brief account of the events that led to the proposed reorganization of the American Engineering Standards Committee, in order that the referendum vote of the Bureau of Standards may not be prejudiced by published articles based upon what I believe is a serious misapprehension of the situation.

The matter is of great and far-reaching importance, and there is no need for haste in coming to a conclusion. Full and sympathetic consideration should be given to the question. If anyone doubts the wisdom of the proposed plan, he should attempt to formulate a better one for accomplishing the end in view. Fortunately, there is no conflict of interest to confuse the issue. Everyone desires to see engineering and industrial standardization promoted. Everyone desires to see a large degree of coöperation in such work among the various societies and between such societies and Governmental agencies. Everyone wishes to see fair play, with the recognition of the rights of all, and to discourage the spirit of autocracy either in engineering societies or in Government departments. Since we are in full accord as to all the ends in view, it is only a question of method; and when the circumstances are understood alike by all, it is believed that full agreement will readily be reached.

The American colonies found grave difficulties when they combined as a nation because they had to surrender some of their independence. Engineering societies cannot coöperate systematically without recognizing each other's rights and therefore surrendering some of their own independence. But they cannot exercise their functions independently, in the absence of such coöperation, without frequent conflicts and duplication of effort. We must choose between conflict and coöperation. The members of the American Engineering Standards Committee have recognized the logic of the situation, and have proposed a wise and generous action.

They have outlined a plan, for presentation to the founder societies, whereby the present organization can proceed with business at once but take in new organizations as they apply and qualify (when the constitution is amended), and, when the membership has increased sufficiently to justify it, divide up into divisions and create a smaller Standards Committee with a central executive committee. It will thus gradually become the great national body it should be.

Neurasthenia a Growing Disease in Engineering Work

May Be Caused by Accident, Overwork, Grinding Routine or Outside Worries—Expert Care Imperative

By Chesla C. Sherlock

Des Moines, Iowa; formerly Secretary of the Iowa Industrial Commission, Workmen's Compensation Service

NEURASTHENIA is a disease which is becoming more and more common in the civil engineering field. It is already grounded in contracting work and seems to be gaining a foothold in the structural iron and steel trades. This fact is causing large employers, as well as those engaged in administering the workmen's compensation acts, to demand more of a knowledge of this unusual disorder.

Neurasthenia means "nerve weakness." In medical terms, it is "a condition of nervous debility supposed to be dependent upon impairment in the functions of the spinal cord."

Some think malingering is due to a neurasthenic condition and others consider malingering and neurasthenia as the same thing. Malingering is not necessarily dependent upon the state of the nerves. In fact, the malingerer is generally a fraud. He knows that he is able to do an honest day's work, but he prefers to loaf while making others believe that he is incapacitated. While we have a plain case of deception and fraud in malingering, the sufferer from neurasthenia is so impaired in his nerve forces that he honestly believes that he is incapacitated and unable to resume his employment.

Viewed from the exterior, the two conditions may at times appear to be identical. Without the aid of medical science we probably would have no means of discriminating between the two. A clever malingerer is worse than a neurasthenic; he may prolong his fancied condition for an indefinite period, while the neurasthenic may become himself at any time and return to work.

Neurasthenia may be caused, in an industrial sense, by a number of conditions. I venture the suggestion that "shell shock," as it is known in the trenches, is closely allied to certain conditions arising in industrial employment which might be characterized as "industrial shock." The latter we have called neurasthenia in the past. It may be caused by overwork, too much of a "grind" which exhausts the nerve forces of the worker, rendering him nervous, sensitive, high-strung and an easy prey to mental ills. However, it is accidents and injuries that more often lead the individual of weak nerve force to neurasthenia. Then, again, it may develop from sources entirely outside the employment, such as domestic worries or financial distress. One authority states that it is the result of "misplaced imagination."

Employers should treat the neurasthenic with consideration and not be too ready to class him as a malingerer. Oftentimes the charge that "there is nothing wrong with you" has caused the neurasthenic to suffer greater mental and physical distress than was warranted.

It seems that the neurasthenic condition can arise from all manner of injuries which a workman may commonly receive in normal industrial employment. One man slipped under a heavy load; another lost a hand, still another wrenched his back, and another received a blow on the head which caused him to have ringing sensations in his head for several months. Only experts should be allowed to handle such cases. As neurasthenia is a nerve disorder, it may extend over a period of several years and absolutely incapacitate a man from carrying on his trade. During that time he is subjected to a diseased mind and disordered nerves, rather than to physical disability. He is, none the less, incapable of work.

Neurasthenia is as interesting, as dangerous and as powerful as "shell shock"—and as pitiable. Both cause losses that are unavoidable and both can be corrected if taken in time.

Reinforced-Concrete Culverts Under Irrigation Canal

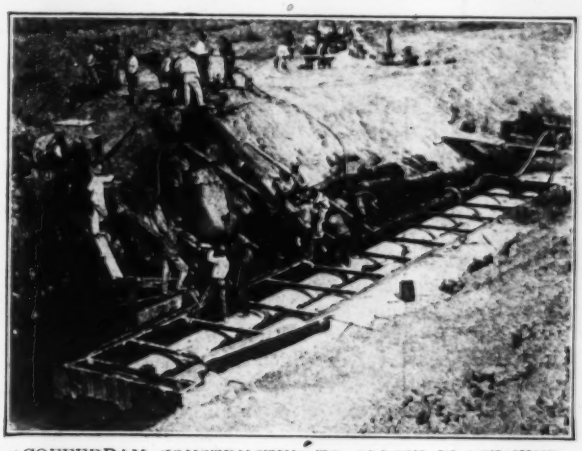
After Many Experiments Engineers on Rio Grande Project Adopt Cradle Construction for Drains in Quicksand

By D. C. Willett
El Paso, Tex.

After much experimentation and many failures in the construction of drains under irrigation canals, there has been developed a type of reinforced-concrete culvert, for use in sandy soil, which is proving satisfactory.

This design has been developed by the engineers of the Rio Grande project in New Mexico and Texas, a special timber cradle being used in connection with the construction of the pipe. A standard drawing has been adopted, as reproduced here, the variable dimensions being lettered and tabulated on each sheet for use in the field.

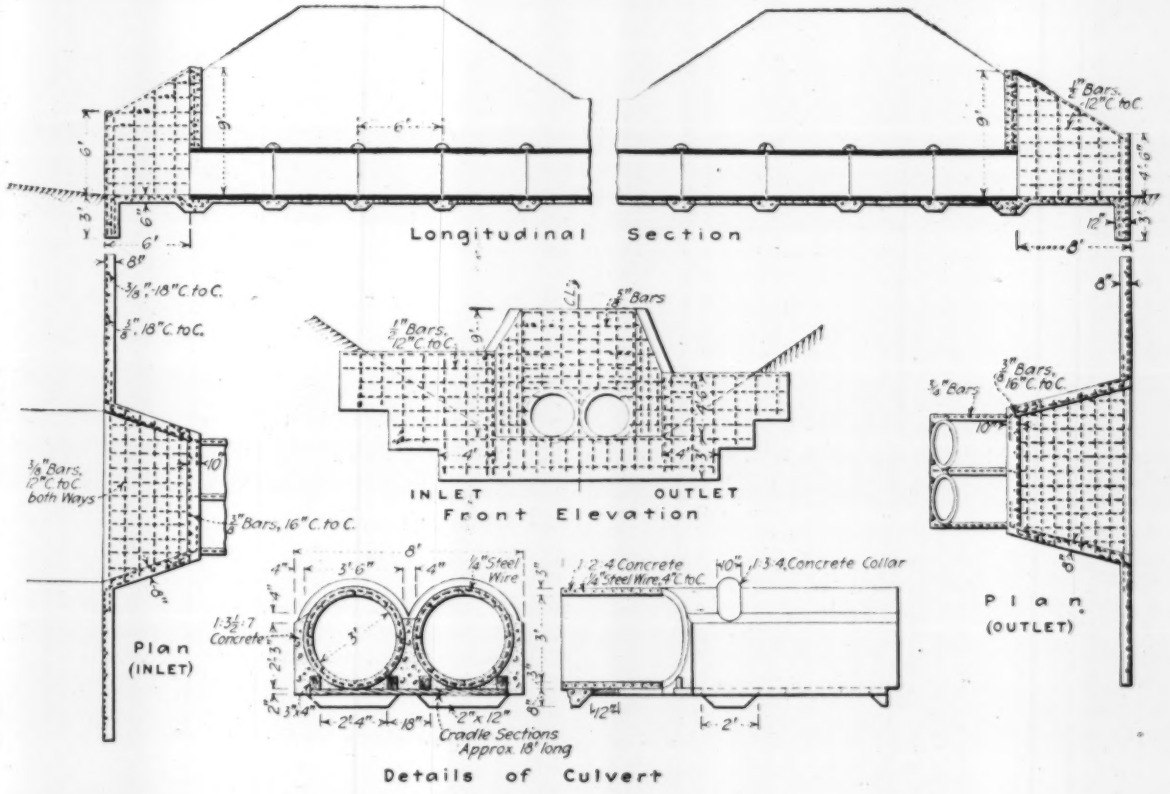
After the timber cradle is laid, to hold the pipe in place, the precast reinforced-concrete pipe are laid by the use of a dragline. A cofferdam is then built, as illustrated in the photograph, with space on one side for the passage of the water from the drain. A small centrifugal pump is set up in a convenient position to pump out the cofferdam and keep it clear of water while the 1:3½:7 concrete is poured around the pipe. Hand-molded concrete collars, 6 ft. apart, as shown, are added for stiffening the pipe and to prevent leakage of water from the canal above. The concrete used in these collars is a 1 : 3 : 4 mix.



COFFERDAM CONSTRUCTED TO ALLOW PLACEMENT OF SUPPORTING CONCRETE

It will be noted from the dimensions of the inlet and the outlet that the latter is designed 18 in. lower than the former, but the thickness of the walls and the spacing of the reinforcing steel are the same at each end.

The picture shows the Franklin drain at Franklin canal crossing, which was 72 ft. long, with an inlet 6 ft. wide and an outlet 8 ft. wide, the wing walls being 12 ft. long. The total cost was approximately $2800, complete.



DETAILS OF REINFORCED-CONCRETE CULVERTS DESIGNED FOR QUICKSAND FOUNDATION ON RIO GRANDE PROJECT, NEW MEXICO AND TEXAS

Computation of the Time Required To Fill a Graving Dock

Based on the Method of Filling From an Upper Orifice as Well as From Usual Gate Openings at Bottom of Dock

By Eugene E. Halmos
Designing Engineer, Barclay Parsons & Klapp, 60 Wall St., New York City

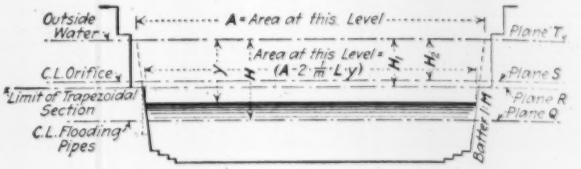
FOR the purpose of filling a graving dock it is customary to provide a series of flooding pipes located near the bottom of and passing through the caisson gate which closes the entrance of the dock. The pipes are equipped with gate valves which are operated from the deck of the caisson. The number and size of these pipes, however, are limited by stability and structural considerations, and if they are the only means for flooding the dock, the filling of the uppermost few feet, as a rule, takes a very considerable time, due to the constantly decreasing head and the increasing area of the dock.

As time is a very valuable element in the operation of dry docks, it is good practice to install an additional opening in the side wall of the dock, located as high as tidal conditions permit and connected with the outside water by means of a culvert. The top of the orifice should be at least two feet below low tide. The filling of the dock is then performed in the following manner: After the keel blocks are properly placed in the empty dock, first only two or three valves are opened in the gate so as to avoid damage to or displacement of the keel blocks due to the inrush of water. When the water reaches a depth of about 3 ft. on the floor, all pipes are opened in the gate. When the water is up about 5 or 6 ft. above the floor a sufficient cushion is created to dissipate the energy of the water falling from the side orifice, and this is opened and kept open, together with all the pipes, until the dock is filled.

Dock Emptied in Three Stages

Until the water inside the dock has reached the elevation of the pipes, the computation of the time lapsing in filling the dock is a very simple matter, both the pipes and the orifice in the sidewall discharging water under constant head. The discharge per second can be readily determined if the proper coefficients are applied. The volume of the dock at any elevation being known, the quotient of the volume and the rate of discharge will give the number of seconds required to fill the dock to the elevation of the flooding pipes or to any intermediate depth. From this elevation on, however, the determination of the time for filling the dock to any greater depth becomes difficult, because the pipes will discharge under a varying head while the orifice still discharges under a constant head. Moreover, the sides of the dock being, as a rule, carried up on a batter, the horizontal sectional area of the dock is also changing from elevation to elevation. The writer has not found, in textbooks on hydraulics, formulas applicable to these conditions, and therefore believes that his method of computation, hereinafter shown, will be of interest, as this problem is met in practically every case of dry-dock design.

In plan, a graving dock is a long rectangle, finished by a tapering or rounded head. By transformation of areas the equivalent length of a dock of the same volume, possessing the normal cross-section throughout, can be easily found with sufficient accuracy. The accompanying figure shows a cross-section typical of masonry graving docks. It can be seen that the determination of the time necessary to fill the dock, from the elevation of the pipes (Plane Q) to the level of the outside water, will have to be done in three steps. Between planes Q and R the pipes discharge under variable head, the discharge of the orifice is constant, and



CROSS-SECTION OF GRAVING DOCK SHOWING DIMENSIONS USED IN FILLING COMPUTATIONS

the horizontal area of the dock is changing. Between planes R and S the conditions of discharge are the same as before, but the horizontal area of the dock is constant. Between planes S and T both the pipes and the orifice are subjected to the same variable head and the horizontal area of the dock remains constant.

Step No. 1. Filling time between planes Q and R. Let

L = The transformed length of the dock with uniform cross-section.

A = The horizontal area of the dock at the level of the outside water, obtained by producing the batter (1 on m) of the sides of this elevation.

Σa = The cross-sectional area of all flooding pipes.

K = The discharge coefficient of the pipes.

b = The area of the orifice in the sidewall.

K_1 = The discharge coefficient of the orifice.

H = The initial head on the pipes.

H_1 = The head on the pipes when the water in the dock is at plane R.

H_2 = The initial head on the orifice and the head on the pipes when the water in the dock is at plane S.

C = The constant discharge of the orifice under head H_2, being $= K_1 b\sqrt{2gH_2}$ volume units per second.

y = The distance of the inside water level from the outside water plane at any instant.

t = The time required to fill the dock between any value of y to any other value (between H and H_1).

The horizontal area of the dock at any depth y below the headwater is expressed by

$$A_y = A - 2Ly/m \qquad (1)$$

The discharge of the pipes and the orifice during an infinitely small time element will produce an infinitely small increment in the height of the water inside the dock, the volume of discharge and the volume of the increment being equal.

Thus:

$$(K\Sigma a\sqrt{2g}y^{\frac{1}{2}} + C)dt = (A - 2Ly/m)dy \qquad (2)$$

$$dt = \frac{Ady}{K\Sigma a\sqrt{2g}y^{\frac{1}{2}} + C} - \frac{2Lydy/m}{K\Sigma a\sqrt{2g}y^{\frac{1}{2}} + C} \qquad (3)$$

Making the following abbreviations:

$$\left.\begin{aligned} \frac{A}{K\Sigma a\sqrt{2g}} &= B \\ \frac{2m}{K\Sigma a\sqrt{2g}} &= D \\ \frac{C}{K\Sigma a\sqrt{2g}} &= C_1 \end{aligned}\right\} \quad (4)$$

Equation (3) may be written:

$$dt = B\frac{dy}{y^{\frac{1}{2}} + C_1} - D\frac{y\,dy}{y^{\frac{1}{2}} + C_1} \quad (5)$$

The integration of equation (5) between the limits H and H_1 will give the time required to fill the dock between planes Q and R.

$$t_{H_1}^{H} = B\int_{H_1}^{H}\frac{dy}{y^{\frac{1}{2}} + C_1} - D\int_{H_1}^{H}\frac{y\,dy}{y^{\frac{1}{2}} + C_1} = I - J \quad (6)$$

Put $y^{\frac{1}{2}} + C_1 = z$, then

$$y^{\frac{1}{2}} = z - C_1$$
$$y = z^2 - 2C_1 z + C_1^2$$
$$dy = (2z - 2C_1)\,dz$$

$$\frac{dy}{y^{\frac{1}{2}} + C_1} = \frac{2z - 2C_1}{z}dz = \left(2 - \frac{2C_1}{z}\right)dz$$

$$\int\frac{dy}{y^{\frac{1}{2}} + C_1} = 2\int dz - 2C_1\int\frac{1}{z}dz = 2z - 2C_1\log z + const$$
$$= 2[y^{\frac{1}{2}} + C_1 - C_1\log(y^{\frac{1}{2}} + C_1)] + const$$

The first member on the right-hand side of Equation (6) will then become

$$I = B\int_{H_1}^{H}\frac{dy}{y^{\frac{1}{2}} + C_1} = 2B[H^{\frac{1}{2}} - H_1^{\frac{1}{2}} - C_1\{\log(H^{\frac{1}{2}} + C_1) - \log(H_1^{\frac{1}{2}} + C_1)\}] \quad (7)$$

And

$$\frac{y\,dy}{y^{\frac{1}{2}} + C_1} = \frac{(z^2 - 2C_1 z + C_1^2)(2z - 2C_1)}{z}dz$$
$$= \left(2z^2 - 6C_1 z + 6C_1^2 - \frac{2C_1^3}{z}\right)dz$$

$$\int\frac{y\,dy}{y^{\frac{1}{2}} + C_1} = 2\int z^2 dz - 6C_1\int z\,dz + 6C_1^2\int dz - 2C_1^3$$

$$\int\frac{1}{z}dz = \frac{2}{3}z^3 - 3C_1 z^2 + 6C_1^2 z - 2C_1^3\log z + const$$

$$= \frac{2}{3}y^{\frac{3}{2}} - C_1 y + 2C_1^2 y^{\frac{1}{2}} + \frac{11}{3}C_1^3 - 2C_1^3\log(y^{\frac{1}{2}} + C_1) + const$$

The second member on the right-hand side of Equation (6) will become

$$J = D\int_{H_1}^{H}\frac{y\,dy}{y^{\frac{1}{2}} + C_1} = D[\tfrac{2}{3}(H^{\frac{3}{2}} - H_1^{\frac{3}{2}}) - C_1(H - H_1) + 2C_1^2(H^{\frac{1}{2}} - H_1^{\frac{1}{2}}) - 2C_1^3\{\log(H^{\frac{1}{2}} + C_1) - \log(H_1^{\frac{1}{2}} + C_1)\}] \quad (8)$$

The value of (8) subtracted from (7) will furnish the solution, i. e.,

$$t_{H_1}^{H} = I - J \quad (9)$$

Step No. 2—Between planes R and S the horizontal section of the dock is constant. The second term of the right side of Equation (6) therefore vanishes and formula (7) will represent the time of filling if in $B = \frac{A}{K\Sigma a\sqrt{2g}}$, A is taken as the horizontal area of the dock above the level of plane R, and if H_1 and H_2 are put for H and H_1, respectively.

Step No. 3—Between planes S and T both the pipes and the orifice are subjected to the same variable head ranging from H_2 to zero.

Let

A = the constant horizontal area of the dock,

f = the sum of cross-sectional areas of the pipes and the orifice $= \Sigma a + b$

K' = the combined discharge coefficient of the pipes and orifice $=$

$$\frac{K\Sigma a + K_1 b}{\Sigma a + b}$$

then the formula

$$t_{o}^{H_2} = \frac{2A}{K'b\sqrt{2g}}H_2^{\frac{1}{2}}$$

well known from the textbooks, will apply.

It will be noted that in the above discussion the distance from the outside water plane to the center of the pipes and the orifice was used as the pressure head. With the dimensions actually given to these openings, this assumption is entirely justified and introduces a negligible error only. Attention is called also to the fact that the pipe openings become "large orifices" when the head is reduced below perhaps four times the diameter of the pipes, resulting in a corresponding change of the discharge coefficient. It may become necessary, to account for this change, that the steps above shown be subdivided, which, however, can be done without difficulty.

Conservation in the Drafting Room by Simple Methods

Women Without Technical Training Are Readily Adapted to Railroad Work—Economies Effected in Lettering and Blueprinting

By James G. Wishart

Office Engineer, Chicago, Rock Island & Pacific Railway, Chicago

While the world war has affected all lines of business more or less, probably no line or profession in civil life has been crippled to a greater extent than railroad engineering, from whose ranks have been drawn the engineering forces required for operating the many miles of American-run lines in France. The selective service acts affected the forces employed in drafting rooms to a considerable extent, taking large numbers of draftsmen. Therefore, the drafting room of the average railroad engineering department afforded a first-class field for the practice of conservation. To offset the loss of men, steps were taken to increase the efficiency of those left on the work, employ and train inexperienced help not subject to war service, and conserve time and labor by the adoption of labor-saving methods and devices.

In some of the railroad drafting rooms the employment of women for drafting work was inaugurated. As a rule, women engaged in the past in drafting work were employed as artists or in the architectural line, and consequently very few had the technical training required to make competent railroad draftsmen. For this reason women employed in this capacity can be used primarily only as tracers or for copy or coloring work, the original detailing being left to the experienced men in the force. With a competent man in charge of a squad of these women, coaching and instructing them, they can soon be trained to handle practically any class of work which the average draftsman in a railroad drafting room is called on to do.

Specializing the members of the force on different

classes of work also gives good results. For example, estimating, yard design, frog and switch plans, mileage reports, rail and ballast records, recording of completion reports, can each be assigned to certain men. This specialization, however, should not be carried to the extent that but one man in the force is familiar with any class of the work; an understudy should be in training at all times for each one, for the purpose of filling vacancies as they occur. Architectural, bridge and signal work are distinctive classes of work and should be handled by men specially trained in these branches of engineering.

Titles, certificates, specifications, prominent lettering, etc., can be applied to tracings in a very short time and at small cost by the use of a small hand printing press. By the use of a special printing ink which is manufactured for use on tracing cloth, work done by this process can be made permanent and sufficiently opaque for blueprinting. A press of this kind has been in the chief engineer's drafting room of the Rock Island for the past 17 years, and in that time has amply demonstrated its usefulness as a labor-saving device. The one referred to is an ordinary hand press capable of printing sheets up to 8 x 12 in. Standard lead type is used, the assortment of styles of letters having been selected to meet the requirements of the work handled.

The work of setting the type and printing on the drawings is performed by the file clerk, who gets a much lower salary than those paid to the draftsmen. It is, of course, desirable where possible to obtain for this work a young man who has had some experience in a printer's shop. Anyone familiar with the time consumed by a draftsman in lettering a single title by hand where something more elaborate than plain lettering is desired can readily realize the saving in time and money made by the use of the printing press, when he learns that little more than half an hour is required by a boy with a little experience to set up and print the most elaborate title on one sheet, and that it requires only a minute or two to reproduce it on other sheets as often as is desired. In addition to the economy effected, uniform work, neat in appearance, is obtained on all drawings. Electrotypes for commonly used phrases, such as the company name, scale, department name and map headings, effect further savings in the time required for setting the type. Standard blank forms can also be printed from electrotypes at low cost in any spare time which the printer may have.

Making of Blueprints

Blueprints can be made from tracings printed in this way immediately after the printed matter is applied, this being accomplished by sprinkling a light film of fuller's earth over the damp ink and immediately dusting it off lightly with a feather duster. While this may give the ink a grayish appearance it does not detract from its opaqueness. Where possible, however, it is preferable to allow the ink to dry for about 12 hours.

Statements, estimates, specifications and similar matter of which a considerable number of copies are desired can be typewritten on a thin, white transparent paper with a black ribbon and a sheet of fresh black carbon paper reversed on the back. Blueprints or blueline prints of first-class quality can be made in any amount from sheets made up in this way. This method is of particular value where the number of copies desired is not large enough to warrant sending it to a printer. We have accomplished a large saving in our valuation work by writing up all of our land schedules in this way and having them placed on the original right-of-way tracings by the lithographic reproduction process at the time when our reproductions of the maps were made for filing with the Interstate Commerce Commission, thus eliminating lettering of these schedules by hand on the tracings. The money saving by this scheme averaged about 75c. per sheet, which on 2500 sheets, the approximate number we made, amounted to $1875, or practically the time of one draftsman for 16 months.

Lithographic Reproduction

The lithographic reproduction process of making copies of tracings offers many opportunities for saving time and expense in making duplicate copies. By this process copies can be obtained on tracing cloth or paper which, provided the originals are in good shape, are practically as good as hand-made tracings, and as true to scale as the originals. In this process it is possible to eliminate portions of the original from the copy or to insert additional details. This makes possible the use of a set of plans made up for one purpose for making plans for a similar structure where changes are desired in the details. By the reproduction of the original plans with such features eliminated as are not to be incorporated in the new plans, and making the desired changes and additions on the reproductions, most of the time of retracing can be saved and a great saving in expense accomplished. This is particularly adaptable to the duplicating of floor plans in architectural work, and also to the producing of plans of structures where a standard plan can be used as the basis for the reproduction. Where there is any amount of work on the original, the cost of the reproductions is but a small fraction of the cost of retracing by hand, and the chance of errors in copying is entirely eliminated.

The practice of photographing standard plans effects a large saving in blueprint paper and time of printing, and can be applied to any large drawings of which a large number of copies are required, or copies of which are to be incorporated in reports, attached to contracts or put to other similar uses. On our prints of standard plans we save approximately 90% on blueprint paper by using prints of the photo negatives instead of the large-size tracings for filling all current requests, and in addition make a noticeable decrease in the size and weight of packages of prints for mailing. These photograph negatives are made on a 9 x 14-in. film which can be blueprinted in a continuous blueprinting machine just as tracings are. When properly made they will print at the same speed as tracings, and they can be used to fill up open spaces on the paper, thus utilizing what would otherwise be waste paper. With a first-class camera and lens, a dark room and an illuminating frame, these negatives can be made at comparatively small expense by any one with the average amateur photographer's knowledge of photography, and with ordinary care in handling they will last indefinitely. We have made as many as 2000 prints from a negative at an average cost of 1c. each, the negative costing about 80 cents.

Possibly the blueprinting department affords a greater opportunity for practicing economy than any other department in the office end of the engineering

forces, especially at the present time, when the prices of blueprinting papers, chemicals and other supplies are more than 200% above normal. The continuous electric printing, washing and drying machines speeded up the blueprinting considerably more than 100% over the old method of printing with a sun frame, but at the same time they also increased the possibility of waste in paper, and raised the repair bills on equipment. The preventive for these is the employment of an experienced commercial printer in charge of the blueprinting equipment—one who will watch to see that the tracings are fed to the machine in such positions as will best cover the entire width of the paper, and without spaces between their edges, and who can also take care of the minor repairs necessary from time to time on the equipment. While it is necessary to pay a larger salary to such a man than to a boy or inexperienced man, the saving he will effect in materials and repair bills, to say nothing of the increased life of the equipment, will more than cover the increase or difference in salary. The use of 100-yd. rolls of paper, by decreasing the number of joints, reduces the waste in paper due to joining the ends of succeeding rolls. The attachment to the washer of a device for recovering the bichromate of potash solution after it has been sprayed on the exposed paper reduces to a minimum the waste of this chemical. Such a device, which is nothing more than a galvanized-iron tray and drain pipe, can be made in the company shops at very small expense, and, considering the high price of potash at the present time, will pay.

Graphical Map Index

The installation of a graphical index for station maps, right-of-way maps and profiles has been the means of saving a great deal of time in our drafting room, by eliminating the necessity for referring to card or book indexes to find the required index number for these drawings, which are the most frequently used in the files. Briefly described, this system consists in filing such records by states, all the right-of-way maps for Illinois, for instance, being filed in one compartment, the door of which is labelled with large letters on the outside, "Right-of-Way Maps 61, Illinois" and a diagram map of the lines in Illinois showing the portion of line covered by each roll of map, with its index number, is placed on the inside of the door. Profiles are filed in the same way, while station plans have an alphabetical list on the inside of the door instead of the diagram map.

By this system of filing, all that is necessary to find a map or profile is to know the state it is in and then to go directly to the compartment labelled for that state and class of map in the filing case and obtain the index number from the diagram on the door of the compartment. This system can be applied as easily to a line with 10,000 miles as to one with but 100, and if desirable the subdivision can be made by operating divisions instead of by states. In the writer's opinion, however, the states plan is preferable, as state boundaries seldom change, while operating divisions are not so stable.

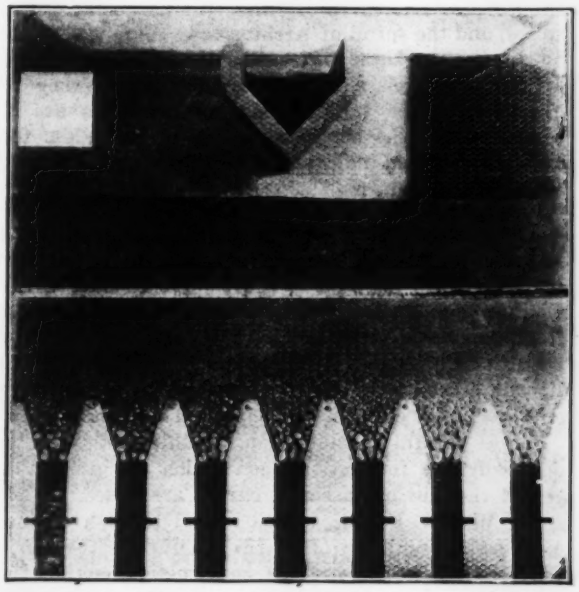
One of the most convenient appliances of which use can be made in the drafting room is a paper cutter such as is used in job-printing offices for cutting large numbers of sheets of paper at a time. We installed one of these cutters capable of cutting sheets 16 in. wide, about five years ago. It has proved a time-saving machine and is in constant use, not only by our own office but by nearly every other department in the general offices. Scrap paper from various sources suitable for scratch pads has been trimmed by this machine to pad size and made up into pads by the office boy, padding cement being used, in such quantities that we have not included a single scratch pad on our stationary requisitions in more than four years. Use can be made in this manner of obsolete report forms, circulars, specifications, etc., printed on one side only.

A drawing pencil just now is a fairly expensive article. The pencil holder is the best known medium for saving pencils and reducing pencil bills.

The last and possibly the most important item that the writer has in mind is *esprit de corps*, or what is more universally known as "team work." The force of men who are receiving the fair and square treatment which is due them and who are being accorded the small privileges it is always possible for their superior to extend them will develop the spirit of team work, and its effect will be to produce better and more work.

Model Explains Water Filter to Visitors

ONE of the difficult things to explain to laymen visiting water-works filter plants is the construction and operation of the underdrain system. At the Minneapolis filters a full-size model has been constructed with a wire-glass front to retain the 30 in. of sand and the six supporting gravel layers 14 in. deep. The model is 18 in. thick and shows seven troughs with the monel metal screens leading to 3½-in. cast-iron risers which were split with a power hack saw to show the section. Wood is used for the ridge blocks and wash-water



WIRE GLASS CONFINES SAND IN FILTER MODEL

trough, being painted the color of concrete. Two sheets of 44 x 88-in. wire-glass form the front, the joint being covered by a metal strip held by three ¼-in. rods. The glass is held also by No. 10 screws driven into the ridge blocks, holes being bored through the glass with file and turpentine. The model was built under the direction of W. N. Jones, engineer in charge of the filter plant and new construction.

History and Use of Easement Curves for Railroads

Review of Bibliography of Subject Indicates Great Variety of Curves Proposed—How Practice Developed

By Philip O. Macqueen
Baltimore, Md.

AT THE very beginning the writer wishes to state definitely that he has no intention of bringing forward any new theories or formulas for easement curves. The various methods now in practical use are explained clearly in a great many handbooks and other sources of reference, and it is the general opinion that a new method is entirely unnecessary. However, a short time ago the writer had occasion to make a brief study of the subject. In this connection he reviewed all of the bibliography to which he had access, and the following discussion may lead to a more uniform practice in the use of easement curves.

An idea of the extent of this lack of uniformity is gained by a summary of the names now in use, as follows:

The cubic spiral easement curve; the transition curve; the easement curve; the taper curve; the true transition curve; the elastic curve; the railroad spiral; the six-chord spiral; the ten-chord spiral; the railway transition spiral; the cubic spiral; the true spiral; the cubic parabola; the railroad taper, and the curve of adjustment.

In addition, the following complete curves have been suggested: The curve of sines; the parabola; Carnu's spiral, and the spiral of Archimedes. As is well known, however, all of these various curves, with the exception of the second class, can be divided into a very few groups in which the fundamental principles are the same, so that the actual confusion is much less than appearance would indicate.

Earliest Reference to Subject

The earliest important reference which the writer was able to find on the subject of easement curves is in Prof. W. J. M. Rankine's book, "A Manual of Civil Engineering," published in London, 1862. Professor Rankine gives a description of two curves, one proposed by Mr. Gravatt in 1828-1829 and one by Dr. William Froude about 1841. The first proposed the use of the curve of sines or harmonic curve. The second method deserves careful consideration, as this method is undoubtedly the foundation upon which the present accepted theories of easement curves are based.

Dr. William Froude, a well known English engineer and naval architect (1810-1879), during the period 1837-1844 was employed as construction engineer on the Bristol & Exeter Ry., England, when he proposed his "curve of adjustment."

Dr. Froude's rules, using his own words, are as follows: (1) Locate the center line of the railroad, using simple curves and tangents; (2) determine the length of the curve of adjustment by means of the formula $L = 300$ multiplied by greatest change of cant (in feet); (3) compute the shift as follows: Shift $= L^2/24 \times$ radius; (4) set out the curve by use of the formula $y = 4bx^3/a^3$, in which a = length of curve of adjustment; b = shift or gap; x and y = ordinates. The important similarity between Dr. Froude's curve and the curves now in use will be seen immediately. However, a period of nearly 40 years elapsed before the principles of this curve were put into into practical use. In fact, the use of easement curves began just a year after Dr. Froude's death.

During the period between 1830 and 1880 no practical use was made of easement curves on railroads, either in England or in the United States. In France, according to W. M. Gillespie, the parabolic curve was generally preferred. A simple method of locating the curve is given in his book, published 1849. It was recognized, however, almost in the beginning, that there was a decided element of danger in the use of simple curves—or, in fact, in the use of curves in general. It was also recognized that, in general, it was not the curvature but the change of curvature that presented the chief difficulty. Laws were made to fix the minimum radius for curves.

On the early English main lines no curves of less than 80 chains (about 1°) were allowed, but later this was reduced to 40 chains and then to 30 chains or about 3°. In the United States the minimum radius allowed on the Hudson River R.R. was 2062 ft. The superelevation of the outer rail was calculated by the same method as is now in general use and applied carefully. When consideration is taken of the easy curves and the comparatively low speed, 15 to 30 miles an hour, customary from 1820 to 1840, it will be seen that railroad travel was quite safe in this respect.

After 1840, however, a higher speed became customary, and practical methods were put into use to overcome the shock due to the almost instantaneous change of direction and sudden development of centrifugal force as the train passed from tangent to curve and curve to tangent. The first practice was to begin to elevate the outer rail on the tangent at a point from 100 to 200 ft. from the point of curve and point of tangent. The superelevation was changed gradually and reached its correct maximum at the point of curve or a short distance beyond the point of curve. This method, however, was only a partial solution of the problem, and the curious and interesting development of allowing the trackmen to "ease" off the curves soon became prevalent. As described by A. M. Wellington, this method is as follows: "The trackmen extend the curve back on the tangent usually 200 or 300 ft. by throwing the line inward at the tangent point, thus sharpening the curve beyond the tangent point, but easing the approach." This method is still in use by a few railroads both in this country and abroad.

Easing-Off Method Criticized

The result obtained by allowing the trackmen to "ease" the curves was a decided improvement over previous methods, but very naturally it caused considerable discussion among the more theoretically minded. William Airy in the *Engineer* of Nov. 27, 1868, deplores the custom and says that he saw two cases of derailment due entirely to the kinks in the curve caused by the easing-off process. In the discussion which followed this article one critic recommended that he "sack the platelayer." Nevertheless, the platelayers in gen-

eral were not sacked, and this method of curve easement was used with a fair degree of success for a period of almost 40 years, or from approximately 1840 to 1880. Dr. Froude's curve of adjustment, the cubic parabola, the elastic curve, and many others were advocated continuously, but the general opinion among construction engineers was that the adoption of these curves would simply be a case of too much refinement. In their turn, the locating engineers adhered strictly to the circular curve, on account of the simplicity with which it could be applied. Mr. Airy very amusingly notes that the "platelayers" considered it part of their duty to correct the mistakes made by the engineers.

That there existed a great necessity for correctly established easement curves was strikingly shown by C. D. Jameson in a series of three articles on the cubic parabola in the *Railroad and Engineering Journal* of May, 1889. Mr. Jameson says: "The author made a survey of 271 miles of railroad, which had been in operation for about 25 years. The survey was made with the idea of getting the alignment of the railroad exactly as it was at the time. All of the curves showed clearly upon being plotted that their ends had been eased off and a sharp point created a certain distance beyond the curve point. This was so in all cases and was due to the impact of the train and also to the work of the section men. The movement had been from 3 to 4 ft. from its original position, thus necessitating a continual widening of the roadbed upon the outside of the curves near their ends. This excessive width of roadbed was the first thing which called the author's attention to the condition."

First Practical Use

The first practical use of easement curves is accredited to E. Holbrook, in 1880. The curve is known as the "Holbrook spiral" and was used originally on the Pan Handle R.R. This curve gained recognition immediately, and is now in use on many railroads. The first engineer other than Mr. Holbrook to use the formulas extensively was G. W. Kittridge, who put spirals on many of the curves on the Pan Handle R.R., both east and west of Steubenville, Ohio. The general formula for the Holbrook spiral is given in the *Railroad Gazette* of December, 1880, and *Engineering News* of June 13, 1901, p. 429, and is $RL = A$; in which R = radius of curvature of spiral at any point; L = length of spiral measured from its origin; A = constant which determines the rate of transition.

The success attending the use of the Holbrook spiral created a renewed interest in the subject, and many new methods and formulas were soon brought forward, both in books and periodicals. An important article by A. M. Wellington was published March 11, 1881, in the *Railroad Gazette*. The "railroad spiral" by William H. Searles was published in book form in 1882, and it is one of the best known of all of the easement curves. In many cases, however, the railroads themselves used easement curves which were developed in their own offices and which were given only to employees in the form of blueprints. With the exception of the Searles spiral most of the new methods and tables were published during the period from 1890 to 1900. It is important, however, to note at this point that, although a renewed interest in easement curves was taken after 1880, nevertheless the railroads were slow to adopt them, and it was not until after 1900 that their use became general.

In 1911 a subcommittee of the American Railway Engineering Association made an examination of all of the different forms of easement curves in use. Their final report, which is published in the "Manual," 1915, contains the following: "Any form of easment curve is satisfactory: (1) In which the rate of increase in degree of curve can readily be changed to suit particular cases so that the length of easement curve shall be the same as the distance in which the outer rail is raised from nothing to full elevation; (2) which can be run in by deflection or by offsets with chords of any desired length; (3) which is of the general type of either the Searles spiral, the cubic parabola, or the Holbrook, Crandal, Talbot, and ten-chord spiral." The ten-chord spiral was recommended by the committee.

At the present time no railroad of any size is located or built without proper allowance being made for curve easement. The larger problem, however, is to "ease" the curves of roads in operation. In the *Railway Age Gazette* of June 17, 1910, the editor discusses at length the answers to a series of questions sent to 56 of the large railroads of the United States. On 20 railroads easement curves had been put in on all main lines and some branches, on nine railroads 75% of this work had been done, on 22 railroads more or less work had been done, and on five railroads no work had been done. The methods used varied considerably, but nearly all of them were based on the Searles spiral, the Holbrook spiral, the Talbot, Hood, and Stevens six-chord spiral, and easement was applied to all curves requiring an elevation of 2 in. or more for the highest possible speed. The consensus of opinion of the railroads in question was that the easing of curves resulted in, first, increase in comfort in riding and avoidance of swerving and unpleasant shocks to passengers; second, economy in track maintenance and reduced flange wear, and, third, reduced drawbar pull.

Strength of Waterproof Glues Wet and Dry

IN A recently issued sheet of "Technical Notes," the Forest Products Laboratory, Madison, Wis., gives information on the resistance of waterproof glues to water. Two types of such glues are in the market, those made from blood albumen and those made from casein.

The former must be used in a hot press, while joints made with casein glue are clamped together cold, for which reason the former are generally used only for thin material, such as veneer. Both kinds of glue are materially weaker wet than dry. Tests of casein-glued joints of wood showed generally only 20 to 40% of dry shearing strength. Similar tests of joints made up with blood glue showed strengths of 50 to 75% of the dry strength. However, when plywood made up with these glues is redried after being soaked, the original strength of the glue is very largely recovered.

The water-resistant qualities of both kinds of glue are so high that the acceptance test for plywood made up

with these materials requires no separation of the plies to be shown after either boiling in water for eight hours or soaking in cold water for 10 days. Airplane manufacture has called for the development of the highest attainable requirements by glues for making built-up structural members out of layers of thin stock. Under present commercial conditions, casein glues, when used to join maple test pieces, show shearing strength of 2000 to 2500 lb. per square inch. Blood glues show higher average strengths (no figures are given), but the laboratory expresses the belief that casein glues will in time be developed to the point of equalling them.

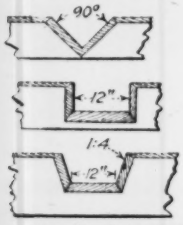
A Universal Weir Chart

By E. Earl Glass
Monrovia, California

IRRIGATION engineers and others using weirs for measuring comparatively small streams may find the accompanying chart valuable for ready determination of the discharges. The formulas are those evolved in the recent experiments conducted at Fort Collins, Colo., described by Victor Cone in Farmers' Bulletin 813 (United States Department of Agriculture, Washington.

The usual precautions must be observed in setting the weir and making measurements. A sufficient pondage should be provided to check the velocity of approach and the head, H, must be reared above the sharp-edged crest to the surface of still water. There should be sufficient fall below the weir to prevent any influence of backwater, and free circulation of air below the crest must be provided.

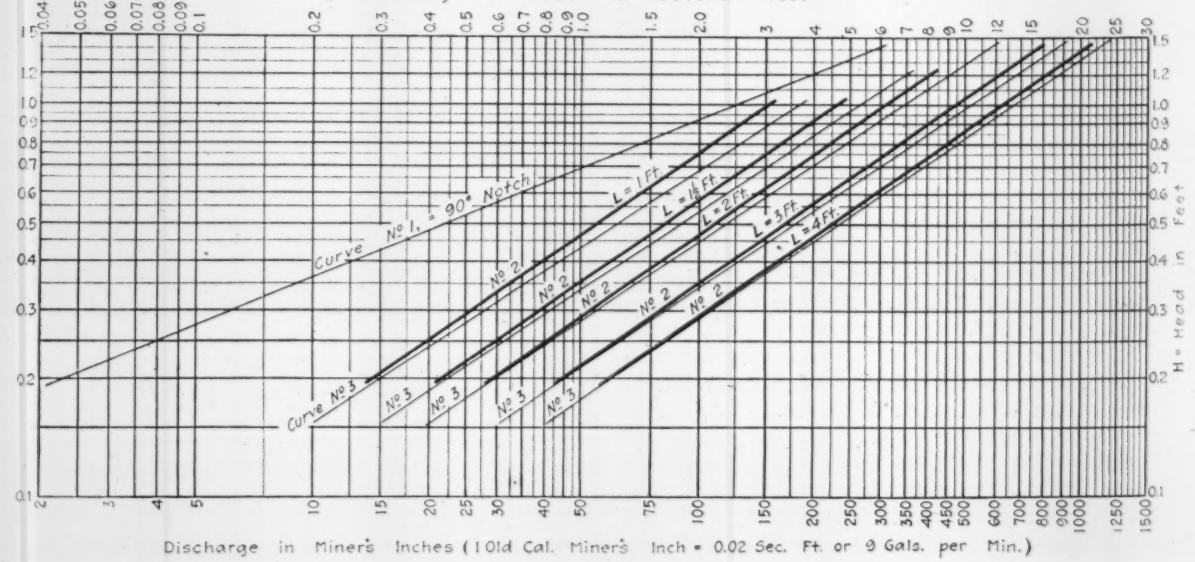
Curve No. 1 gives the discharge of a 90° triangular notch weir for heads to 18 in. The discharges of rectangular weirs for the same range of H are indicated by Curve No. 2, and the same for trapezoidal or Cipolletti weirs with length of crest, L, equal to 1, 1½, 2, 3 and 4 ft. are shown by the four curves marked No. 3. The discharges read from this diagram in cubic feet per second or in miner's inches agree with the tables in the publication mentioned above.



Curve No 1 = Discharge of 90° Triangular Notch Weir by Formula, $Q = 2.49\,H^{2.48}$

Curve No 2 = Discharge of Rectangular or Francis Weir by Formula, $Q = 3.247\,LH^{1.48} - \frac{0.566\,L^{1.8}}{1+2L^{1.8}}\,H^{1.9}$

Curve No 3 = Discharge of Trapezoidal or Cipolletti Weir by Formula, $Q = 3.247\,LH^{1.48} - \frac{0.566\,L^{1.8}}{1+2L^{1.8}}\,H^{1.9} + 0.609\,H^{2.5}$


Q = Discharge of Weir in Second Feet
H = Head in Feet
Curve No 1, = 90° Notch
L = 1 Ft.
L = 1½ Ft.
L = 2 Ft.
L = 3 Ft.
L = 4 Ft.
Curve No 3
No 2
No 3
Discharge in Miner's Inches (1 Old Cal. Miner's Inch = 0.02 Sec. Ft. or 9 Gals. per Min.)

Concrete-Frame Factory Building Has Wooden Roof

Cost One-Half of Steel-Frame Design — Roof Sheathing Made Protection Easy During Severe Winter Weather

By W. E. Turner
Civil Engineer With Villadsen Brothers, Inc., Salt Lake City, Utah

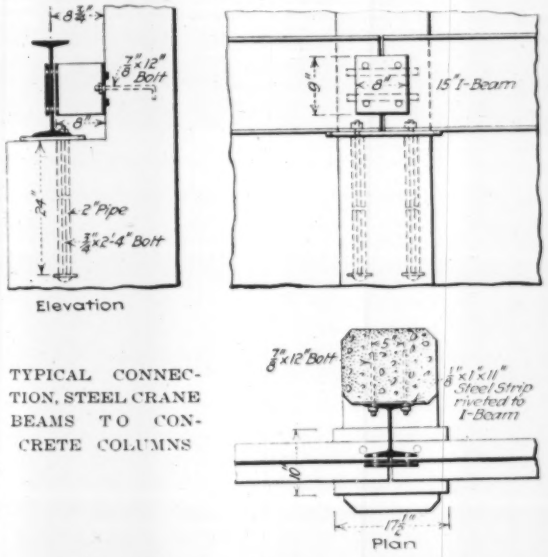
CONCRETE-FRAME construction for factory buildings has so many advantages over steel in permanence, fire-resisting qualities, freedom from vibration, low maintenance, speed of construction and appearance —and, above all, in low first cost compared with steel at present prices—that it is surprising how seldom it was adopted even before the cost ratio became so marked. The main building of the Galigher Machinery Co., Salt Lake City, Utah, was first designed with a steel frame. The bids were so high that an alternative design for a concrete frame with a wooden roof was made, and the new bids developed the remarkable facts that the concrete frame cost one-half as much as the steel frame, and that the chances of delivery favored the concrete materials by 10 to 1.

The Galigher Machinery Co. has a general machine shop business and also deals in various iron and steel products, with a steady output of filter presses. The flood of orders, overtaxing the company's old plant,

made it imperative to rush new buildings to completion during the severe winter of 1916-1917. The extremely favorable showing for the concrete frame was obtained simply by replacing the original open framework of steel beams and columns by one of concrete beams and columns, the roof and walls being filled in with other materials chosen with reference to their cost and appearance.

It was decided to build a wood roof on the concrete frame, utilizing for economy the large amount of form lumber which would have had to be sold at great sacrifice. A built-up sanded roofing with an asphalt base was used on the main building, but the rapid fluctuation in the prices of materials had altered the conditions before the warehouse was completed, and a tar-and-gravel roof was therefore adopted for that building.

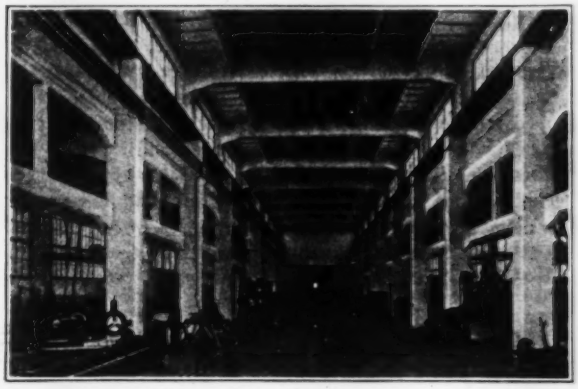
One of the principal factors in keeping the cost on the concrete frame so much below that of steel was the uniformity of the design. Each bent is a duplicate of the preceding bent, and each beam has a corresponding beam in the next bay. The uniformity of the design reduced the cost of form detailing, and permitted the division of the building into three sections. The forms for Sec. 1 were re-used with practically no alteration on Sec. 2, and after that again on Sec. 3. The whole arrangements was so standardized that it was possible to carry the work out more or less like a manufacturing process.



TYPICAL CONNECTION, STEEL CRANE BEAMS TO CONCRETE COLUMNS

A steam-driven stiffleg derrick with a 50-ft. boom, set on a truck, was placed to operate in the clear space down the center of the floor.

The forms came to the erecting floor from the saw mill in finished beam-and-column units, and were piled at the sides of the derrick under the boom, each piece placed according to a carefully prepared piling diagram. All reinforcing steel was fastened in place in the forms before erection. The derrick picked up the forms for the concrete framework and swung them into place. All that the carpenters on erection had to do was to drive the nails. As soon as a bent was set the derrick would swing the wooden purlins, rafters and sheathing into place, pick up the two steel crane beams, and then proceed to the next bent.



INTERIOR OF SHOP BUILDING

Lower beams and intermediate columns are for support of shafting and machinery

Every unit of form was detailed in the drafting room. Provision was made, as seen in the drawing reproduced, for setting little brackets for the support of wood purlins, and throats were cut in the top of the form, to set the purlins in place during the form erection. The beam sides when stripped came off very easily, and left the purlins and all the roof in place. The sheathing and rafters were laid during form construction, so that they provided a good working platform for the pouring of the concrete, and covered in the roof area as part of the frost protection while the concrete was setting. Provision was made in designing the forms so that all beam bottoms would be left supported after the rest of the forms had been stripped and remodeled.

The frame beams were mixed 1:4, or approximately 1: 1.4: 2.6, and the columns 1: 6. The grading of the aggregates was carried out as far as practicable by frequent visits to the pit, and by screening samples of sand from every load. As the cold weather had set in before the framework was poured, it was necessary to heat the mixing water and the aggregates. The hot water was obtained from the Utah Portland Cement Co. across the street, taking advantage of heat that was going to waste at the plant. The sand and gravel were heated by means of 2-in. perforated steam pipes laid on the ground under the sand and gravel piles. There was approximately 1 sq.ft. of heating surface in the pipes for each 6 sq.ft. of ground covered by the piles. That was sufficient to keep the materials hot through the coldest weather. The steam was supplied, at a pressure just barely above the atmosphere, by the boiler on the steam derrick, which was in no case engaged in erecting forms at the same time as when the concrete was being poured.

The temperature of the fresh concrete was probably about 120 deg. To protect the concrete still further against the cold, each section of the building was closed in with 8-oz. duck sheets, and salamanders were burned day and night. It was found that the concrete, even when not inclosed, would remain warm to the touch for about 24 hours after pouring. The heating of the concrete was governed by the idea that no dependence can be placed on any setting at a temperature lower than

40 deg. The heat was kept well above this minimum until the cement was well set. As a check on the proper setting of the concrete, test blocks were made in the form of 6-in cubes, and three or four of them were poured with every day's run and placed beside the most exposed beams to set under the same conditions as the framework. They were tested by crushing by Professor Beckstrand of the University of Utah, and his report was always consulted before the supports were removed.

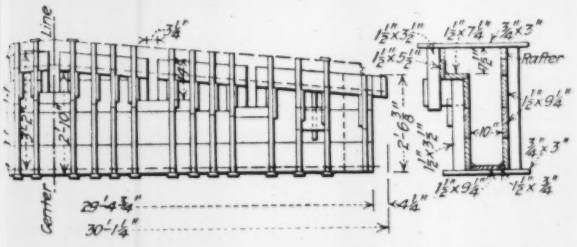
The table herewith gives the results of tests on four of the cubes for the framework of the first section in a portion which was not inclosed, where the concrete was poured at a temperature of 120 deg. and allowed to set for 41 days exposed to a temperature of 10 deg. above zero.

ULTIMATE STRENGTH OF CONCRETE SET AT LOW TEMPERATURE

Mixture	Ultimate Strength 6 × 6-In. Cube	Ultimate Strength lb. per Square Inch
1:4	93,050	2580
1:4	102,400	2870
1:6	52,300	1475
1:6	57,100	1600

The whole interior of the building was whitewashed with hydrated lime, carrying a small proportion of salt, glucose and other ingredients. The woodwork, brickwork and plaster walls were all sprayed, but the concrete was for the most part brushed, in order to fill any little surface voids more thoroughly. The insurance rate on the buildings was quite noticeably reduced by the whitewashing, the saving being as great as 15% in the case of the warehouse. It is claimed that the presence of salt in the whitewash is an important factor in its fire-resisting properties.

Building work was carried on according to a very complete time schedule which showed the number of carpenters, laborers, and other workmen required at certain dates, the time of starting and finishing all subcontracts, and the time limit allowed for the delivery of all material. The time schedule was found of peculiar value in ordering brick, which had to come by the carload, and which could not be stored in very large quantities near the track. The plans for the main building were started in October, 1916, and it was completed ready for use on Jan. 31, 1917.



DETAILS OF 30-FOOT BEAM FORMS FOR MONITOR

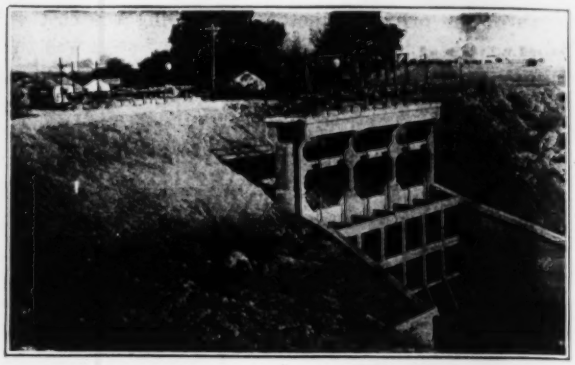
All work on the Galigher buildings was done under the supervision of Villadsen Brothers, Inc., engineers and contractors, Salt Lake City, and Leonard Cahoon, general superintendent of the Galigher Machinery Co.'s shops, all reporting to J. E. Galigher, vice president and manager of the Galigher Machinery Company.

Canal System Used Alternately To Irrigate and Drain

Low-Lift Pumps Required for Part of Area, But Much of It Is Served by Gravity Auxiliary Canals

A COMBINED reclamation and irrigation system, using the same canals for irrigating crops in the dry season and for draining off surplus waters in the flood season, has been developed in California. It is known as "District 108," and includes about 60,000 acres in the lower Colusa basin along the west side of the Sacramento River.

The canal system was first laid out on the reclamation district plan for draining the lands and keeping the water table down to a level safe for crop production. Then, in 1917, the state legislature revised the reclamation act to include provision for irrigation. After careful studies of the area affected, it was found that with the low gradients on which the canals were laid out some comparatively inexpensive changes in the canal system and the addition of headworks would make it possible to fill the canals by admitting water from the river. This necessitated, in some sections, pumping to get the water from the canals on to the land. The lift required was nowhere high, however, and by using a system of auxiliary canals a large portion of the area was served by gravity. The completed canal system will be such that no farming land will be more than two miles from a branch of the main canal system.



WILKINS SLOUGH INTAKE IS PROVIDED WITH TRASH ROCKS, FISH SCREENS AND REGULATING GATES

The general slope of the area is westerly, away from the river, falling 10 to 12 ft. in the first mile and 4 to 5 ft. in the second, after which it is quite level. The normal low water level in the river is about El. 28, practically the same as the ground level upon which 19 miles of the back levee is constructed. The lowest land in the district is about El. 22 and about 28,000 acres lie below El. 28. Thus almost half the total area could be, theoretically, supplied by gravity. The cost of checking is very low because of the regular, level surface.

It is proposed, should there be any temporary shortage of irrigation water, to siphon water in through the pumping plant, at the lower end of the district, installed for pumping out drainage. Another feature of the drainage system that is included in the irrigation plant is the culverts in the Howell Point cross levee near the center of the district. These culverts, provided

with gates at either end, are to be used when desired to maintain a higher water level in the upper half of the district than in the lower half.

The Wilkins Slough intake will control the entry of water from the Sacramento River into the canal system. It consists of six reinforced-concrete culverts 5 ft. square inside and set with the floor level at El. 20. Thus the tops of these culverts are 1 or 2 ft. below the lowest low water. The barrels are about 141 ft. long and terminate in retaining walls.

The intake structure is set back in Wilkins Slough about 150 ft. from the river bank, to avoid injury from river traffic or caving banks, and also because this afforded an easy way to maintain the levee during construction. When the intake was completed the channel to the intake was opened up by a large clamshell dredge during the high-water stage of the river, the levee over the intake culverts being reconstructed by the dredge at the same operation, using material dredged from the inlet channel.

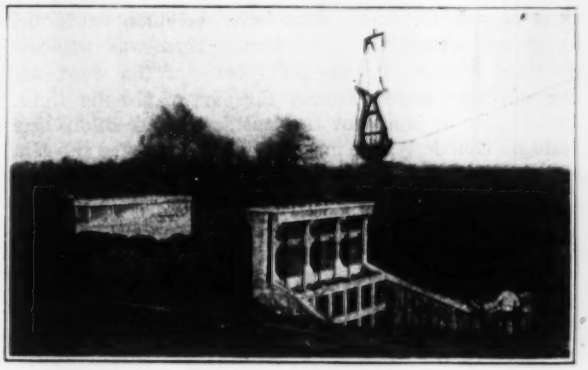
The headwalls on the riverward side support the operating mechanism for heavy, steel regulating gates. In front of these gates, sloping buttresses from the retaining wall also support steel trash racks and fish screens. Grooves were constructed in the concrete walls to permit of an emergency closure by stop logs in case the gates jam. As an additional precaution, reinforced-concrete wells were constructed near the center of the culverts, extending upward to the top of the levee at the landward edge of the crown. A second set of timber regulating gates was provided in these walls, permitting an entirely independent closure of the culverts. Three separate sets of reinforced-concrete collars or cutoff walls are provided. One of these, under each set of gates, incloses a heavy timber sheet pile cut-off wall driven 20 ft. farther into the substrata.

Test borings indicated clay, with a shallow stratum of hardpan to a depth of 10 ft. below the foundations of the structure, and no foundation difficulties developed. The total cost of the completed structure, including overhead charges for engineering, administration, etc., was approximately $100,000.

The intake is connected with the drainage canals by a system of main irrigation canals extending across the head of the district. The system classified as irrigation canals, and used chiefly for irrigation purposes, comprises four main canal divisions with a total length of approximately 11 miles, and a total volume to be excavated of about 751,000 cu.yd. The cost of the canal excavation, as estimated when the work was about 50% complete, was $195,000, or an average of about 26c. per cubic yard.

The canals between the intake and the upper end of the main drainage lateral of the eastern portion of the district were designed with a bottom width of 40 ft., side slopes of 1 on 1½, and a nominal capacity of 500 sec.-ft. The maximum depth of material to be excavated was not over 15 ft. The heaviest cutting was done with a dragline excavator mounted on two lines of car trucks and carrying a 4½-cu.yd. bucket on a 110-ft. boom. Other portions of the canal were dug with a smaller dragline, and with a dipper dredge mounted on car wheels and spanning the ditch.

The larger portion of the work, however, will be completed with floating clamshell dredges with 1¼-cu.yd. buckets, 75-ft. booms, and 28 x 80-ft. hulls. These machines can float in about 4 ft. of water, and can readily lift material to a height of 15 ft. or more above the water surface. Controlling works will be installed at the head of the main drainage laterals just below the junction with the main drainage canal, in order that



LEVEE OVER INTAKE CULVERTS WAS REBUILT WITH MATERIAL DREDGED FROM INTAKE CHANNEL

water may be held up across the district in the irrigation canals, or can be diverted down the drainage canals, as required.

The irrigation and drainage system and the intake were designed by Fred H. Tibbetts, civil engineer, San Francisco, engineer for Reclamation District No. 108. Fred C. Herrmann, consulting engineer, reviewed the plans for the intake. The Ajax Dredging Co., F. F. Cooper, president, of San Francisco, was the general contractor for the entire work.

Cantonment Fire Due to Faulty Masonry in Fireplace

Chimney Built of Scrap Material and Added After Frame Building Was Completed Found Full of Holes After Building Was Destroyed

FIRE in one of the officers' quarters at the United States Army General Hospital No. 3, at Colonia, N. J., last October entirely destroyed the building and caused the deaths of two of the medical officers sleeping in the building at the time, and the injury of several others who were trying to escape. Investigations of the fire were made by various officers immediately after the fire.

As a result of the investigations, it is apparently the opinion of the experts that the fire was caused through the faulty construction of a fireplace which was put into the building after it had been completed and while it was occupied.

The building was one of the typical cantonment-type timber-frame structures, one-story high and E-shaped in plan, having a headhouse and three pavilions extending therefrom. The center pavilion contained a lounge or rest room for the officers, and the remainder of the building was used for sleeping quarters. About six weeks before the fire some of the officers took it upon themselves to have built in one side of the lounge a large fireplace. For the construction of this fireplace

and chimney one of the soldiers in camp who said he was an expert bricklayer was called in.

Engineer officers examining the ruins of the building, which incidentally consisted only of a few charred timbers and the remains of the fireplace, state that the fireplace itself was of very poor construction. It seemed to have been built of scrap material, one officer stating that he had noticed five distinct classes of material and three grades of cement. These materials were 12 x 12 x 8-in. hollow-tile blocks, face brick, common brick, firebrick and concrete. The mortar used was evidently portland cement for the main body of the work with possibly lime added, fireclay for part of the fire lining, and plaster of paris for the last few layers of firebrick lining. Evidently, the mechanic had ransacked the camp for scrap material which he had put together as best he could. Officers examining the chimney after the fire found that it was full of openings which distinctly showed light through and which would readily have communicated fire to the surrounding timber.

A board of examiners, consisting of medical officers, did not seem to think that the fire could have originated in the chimney, but assumed that the start was probably due to either defective wiring or incendiary origin. While the engineer officers' report does not definitely so state, it is very evident that it is their opinion that the chimney was the source of the fire, and there seems to be also an unvoiced criticism of the medical officers for taking upon themselves the construction of a chimney and fireplace without proper engineering advice.

Latin and Greek as Preparation for Engineering

Dr. Mortimer E. Cooley, President of American Society of Mechanical Engineers, Advocates Teaching of Dead Languages

IN AN article published in *The Evening Sun*, New York City, Dr. Mortimer E. Cooley, dean of the colleges of engineering and architecture, University of Michigan, and president of the American Society of Mechanical Engineers, deplores the fact that in the future education of our youth Latin and Greek and other so-called dead languages are to play so small a part. He advocates the teaching of these languages as a means for training engineers for responsible citizenship. Extracts from his arguments favoring this educational procedure follow:

Even as a preparation for engineering I have for years considered that there was no better training than Latin and Greek. Most of the big engineers of today went to college when Latin and Greek were prime in the curricula. They were classical students—many of them. There was comparatively little of engineering science in those days and therefore plenty of time for something else than mere technical training.

Why, then, give our youth a smattering of this and that so-called practical thing as a preparation for college? How much better it is to give them something not only preparing them for college but starting them off in life so as to be of maximum use to themselves and their fellow men. Most young men have only four years in college; they have forty years afterward in which to learn and practice the bread-and-butter part of their life. The one great need today from our educational institutions is training for responsible citizenship.

Starting back in the grade schools, I would eliminate all fads and stress those things which make for an understanding and appreciation of natural things surrounding us.

Toward the end of the grades and before the high-school period I would start in with Latin, giving to it the importance that it formerly had, but teach it not as a dead but a live language; and along with it take up history and the natural sciences, all in preparation for later study of these subjects.

In the high school I would still keep away from fads and hammer away on the fundamentals, stressing all those things which fit one to live one's life better and getting out of it enjoyment for oneself and those with whom one has to live.

The college should follow along the same lines, stressing in the early years the things which make for general training, leaving the special things for a later period. Comparatively little specialization should, however, be done in the college. The work leading to the bachelor's degree should in the main be for general education. Following the college should come specialization in the field of one's life-work.

Advice to Young Engineers

This plan would add a year, perhaps two, but the delay would not really be any handicap. It certainly would not be so in engineering. One large employer of engineers complained that college engineers nowadays were unsatisfactory; that while they knew special engineering things extremely well, they did not know anything else; that what employers needed were young men of parts, those who could take part in activities not of a strictly technical character; that more than all else the world today needed engineers of imagination and vision to see beyond the walls built up around them in college.

For the young American going into engineering I would advise a thorough preparation in fundamentals, eschewing all fads, even manual training and the practical things thought so essential to his success, and including: Not less than two years of Latin, preferably three or four years; considerable history; some political economy; a good knowledge of English and of literature; a speaking knowledge of at least one foreign language, and if only one it should be Spanish; some philosophy and as much as possible of art, music and other things apparently having nothing to do with engineering.

This would bring to the world a type of engineer now rarely met—one, who besides being able to do the things required of him as an engineer, would be able to do other things vastly more important, it may be, and which only one with an engineering training could do. In a word, it would give to the world generals of engineering—masters of organized effort.

Studies of Compound Water Meters

Observations on compound water meters, with a view to their possible adoption by New York City as an aid in lessening under-registration, were made recently by the Department of Water Supply. Some notes on the subject were presented at the February meeting of the New York Section of the American Water-Works Association, by Fred B. Nelson, an engineer in the department. The tests indicated considerable saving. Particular attention was given to the regulating valve control between the small and the large meter. It was suggested that on 4-in. meters, for example, the bypass meter be increased in size so as to operate up to about 5 cu.ft. per minute, when the large meter should come into use and the bypass meter either be cut out, or, at least, the pressure difference on it be so cut down as to divert more abruptly to the large meter a flow sufficient for more accurate registration.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

A Definite Comparison—Engineer's Salary Versus Laborer's Wage

Sir—I have followed with keen interest the discussion in your journal with reference to the compensation received by engineers, as I will graduate from high school this June and contemplate taking up the study of engineering.

Last summer I visited my brother in Dayton, who is a graduate of one of the foremost engineering colleges in America and at the time was employed by the Bureau of Aircraft as a structural designer and was receiving a salary of $150 per month. He suggested that I get a job at McCook Field for the summer, as the Government was badly in need of men. This I did, and as I am unskilled I was hired as a laborer. On Aug. 1, my brother received his usual half-monthly pay, $75, while I received for the same period $80.40. Of course, I had put in considerable overtime, but so had he—including Saturday afternoons, Sundays and three evenings a week till 9.30, the only difference being that it showed up in my pay and not his.

As the result of this and similar conditions described by your readers, I am rather dubious about investing four years and $6,000 in a profession while such a premium exists on ignorance, for I feel as if it will be at least three years after I graduate before I will earn $160 per month, the equivalent of my earning capacity as a 17-year-old laborer.

New York City. LUCIEN ALTER.

More on Shear in Concrete

Sir—Not with the idea of continuing the discussion, but as a suggestion on some matters that the profession would do well to ponder, especially if revision in standards is contemplated, the writer would like to comment once more on the article and letters on the strength of concrete in shear which appeared in *Engineering News-Record*, of Feb. 27, 1919, p. 430, and Apr. 17, 1919, p. 783.

If the maintenance-of-way department of a railroad knew that a certain rail had an incipient transverse fissure, it would remove that rail from the track. There can be no doubt that these fissures and the rail failures that they cause are progressive. Other failures also are progressive. I have seen in broken axles undoubted proof that the failure was progressive. This is shown in the rusted portion of the fresh break, demonstrating that failure had begun some time before. This start of the axle failure is really the ultimate point of its usefulness. Repetition of the same load, or maybe less, is what breaks the axle. In a static test the axle that has started to fail may stand several times the load that it is commonly carrying.

This is a thing of which investigators and writers often lose sight. A concrete column that has begun to crack under a certain load may crack somewhere else under the same load repeated. A beam that has cracked due to excessive shear of diagonal tension under a certain load, may crack somewhere else the next time the same load is applied, and keep on cracking until failure results. This is, then, the real, ultimate strength or ultimate point of usefulness of that beam in shear so far as the concrete is concerned, and not some higher load the beam may stand under very careful application of a static test.

I confess that I did not observe that test 4-AD-1 had flanges and stirrups but no concrete web, as Mr. Slater points out in his letter in the issue of Apr. 17. Why is not this test 4-AD-1 pertinent in determining how much of the shear passes through the web? It shows that even at a great disadvantage these two separated flanges enable the beam to carry half as much shear as one with a web to join them and make them act together. This test proves my contention exactly. Here is a beam without a concrete web which stood a shear about half as great as one with a web measuring nearly 90 sq.in. in area. It is my contention that in a reinforced-concrete beam with a web where the full shearing value is attributed to the concrete web, the unit shear in that web can be made to appear any desired intensity up to infinity by merely reducing the thickness of the web.

Pittsburgh, Penn. EDWARD GODFREY.

Private Employment Agencies Upheld

Sir—In your issue of Feb. 13, 1919, p. 328, C. E. Drayer, secretary of the American Association of Engineers, discussed the establishment of centralized employment offices by the engineering societies, as a means of eliminating the "leeching private agencies . . . sucking from the unfortunate engineer who is out of employment from 50 to 60% of his first month's salary." The following facts are submitted for consideration in this connection:

Under the fourteenth amendment of the constitution of the United States individuals have the right to engage in useful business. The United States Supreme Court in 1917 decided that a private employment agency was a useful business. This decision contained the following phrases: "Not inherently immoral, or dangerous to public welfare"; "such service is useful, commendable and in great demand"; "business is as legitimate as that of a banker, broker, or merchant, and may be said to be a necessary adjunct to modern business"; "business is not only innocent and innocuous but highly beneficial," and that "such agencies have been established for so long a time that they are now one of the necessary means whereby persons seeking employment are able to secure the same."

Private agencies have existed in competition with many forms of free service for many years. Men have not been compelled to patronize these offices, and are not now. The free methods of employment outnumber the paid agencies one hundred to one. The leading engineering societies have operated free employment departments for many years, presumably for the purpose of rendering service to their members as a whole and not as self-constituted redeemers of less than one per cent. of their members, who through choice patronize paid employment agents, against whom the worst that can be said is that they charge commis-

sions, though these commissions are covered in a signed contract in advance, and are contingent entirely upon the acceptance by the applicant of a satisfactory position.

What is to be shall be. If some new scheme of free employment service is to prove all-satisfying, then paid agencies will be no more. Until then, why not presume that the Supreme Court's appraisal of private agencies is correct and cease to insult the intelligence of those who prefer this method of finding employment?

A. G. FROST,
President, National Association of Technical, Educational and Commercial Employment Agencies.
Chicago, Ill.

Distributed Passenger Terminals

Sir—A rather erroneous idea of the terminal and traffic of the Aurora, Elgin & Chicago Ry. is given in the editorial on "Distributed Versus Centralized Passenger Terminals," in *Engineering News-Record* of Apr. 17, 1919, page 752. The trains of this electric railway connect with the Garfield Park branch of the Metropolitan Elevated Ry. at Laramie Ave. and run over this line for 6½ miles to a downtown terminal on Wells St., the west boundary of the loop district. Some of the elevated trains also use this terminal, but most of them go around the elevated loop. The Aurora, Elgin & Chicago Ry. trains do not handle local traffic on the elevated line and do not stop at the stations on this line, with the one exception of Marshfield Ave., a junction point, where inbound passengers can get off and outbound passengers may board the trains. The Aurora, Elgin & Chicago Ry. has its own ticket office and entrance at the Wells St. terminal, separate from the facilities of the elevated railway. Baggage is not handled on the regular trains.

The Chicago, Lake Shore & South Bend Electric Ry. runs certain of its trains over the terminal lines of the Illinois Central R.R. to the downtown terminal at Randolph St. These trains are handled by steam locomotives between Randolph St. and Kensington, 15 miles. Plans have been proposed at various times for bringing other south-shore electric lines into the La Salle terminal station by means of an elevated structure over the right-of-way of the steam lines. It has been proposed also to bring trains of the Chicago, North Shore & Milwaukee Electric Ry. into the city over the Northwestern Elevated Ry. As this electric line has its terminal at Evanston, 12 miles from Chicago, it is felt that it is handicapped by so long a transfer on the elevated trains, as passengers to Milwaukee and intermediate points find it more convenient to take trains of the steam railways at their city terminals.

Chicago, Ill. RAILWAY.

Utilitarian or Scenic Highway Locations

Sir—The writer was very much pleased to see your editorials in *Engineering News-Record* of Apr. 10, 1919, p. 698, in regard to the desirability of making our improved roads scenic rather than straight-line highways. Not only is it usually the case that the contour road involves very much less cost per mile, but, except in very irregular country, it will usually be found that the cost between terminals is also much less, although the distance will be somewhat greater.

The driver of a heavy truck, and for that matter the speed maniac, is chiefly concerned with getting between points in the shortest possible time. But growing sanity in regard to the use of motor trucks, and a better realization of the fact that the use of the 10 or 12 motor trucks required to handle the contents of an ordinary freight car results in a net cost to the community (where the haul is of any length) much greater than the cost of the same transportation on the railroad, whether steam or electric, is rapidly restricting the motor truck to its proper field of short hauls in the city, while the furious speeders are after all a small proportion of the users of the highway.

The average man is concerned to no small extent with the beauties of the country, and that road which winds somewhat so that the points of interest develop one by one as the ride proceeds, particularly appeals to him. This fact, in connection with the lower cost, would seem sufficient argument against the straight-line trunk.

Incidentally, there is another point of considerable importance against the latter road, when, as is so often the case, it involves considerable cutting. In a country where there is snow, these cuts serve as accumulators of snow, and, to a very considerable extent blocking of traffic through the winter weather results. This tendency to leave through cuts is often followed, even in cases where one side is little more than a shell. Such a proceeding leads to drift troubles in winter and often serves to spoil what might otherwise be a beautiful view.

The writer has particularly in mind a fine highway from Avon, Conn., to Hartford, over Talcott Mountain, where what should be a marvelous view of the beautiful Farmington River valley is blocked off by such cuts to a very considerable extent. In this case, the addition of a small yardage to make a side-hill excavation would have cleared most of these obstacles away. Unfortunately, this road is anything but an exception. Moreover, I am confident, although in this case I do not know from personal observation, that these cuts are sources of serious trouble in every snowstorm of any moment. CHARLES RUFUS HARTE.

New Haven, Conn.

Thoughts From a Reader and Contributor to Technical Journals

Sir—We sometimes ask ourselves, What is the value of technical articles? The average engineer subscribes to technical journals in the hope that he will receive from them educational benefits in his line. Contractors and machinery makers take them to keep posted on business activities.

Lately the professional journals are taking an active part in trying to better the working conditions of the profession. It is a great and laudable work that strives to obtain for civil engineers the same wages as the aristocratic bricklayers and plasterers have earned for years. Looks as if we had hitched our wagon to the star.

We were too proud to fight, but we finally got busy and did a good job of scrapping in the Argonne. Marquis of Queensberry rules were laid aside. We have been too proud to unionize, but we are hitting

in that direction. "Civil Engineers' Local No. 23 Meets First Wednesday in the Month."

But to get away from sordid money thoughts back to the rarefied atmosphere of technical authorship. Technical journals would do well to solicit longer articles, those in which the author builds up his thought, and thus allows his readers to absorb a little real knowledge. "Be brief" is a good motto for a telegram, but articles which are merely a synopsis impress very few. All articles are not of universal interest. There may possibly be a few persons who read a technical journal from cover to cover, but the majority pick out one or two articles that come within their purview and interest. Consequently, articles that are worth reading should not leave out half the information—an author saturated in his subject expects us to do liaison work between disjointed paragraphs. Instead of being brief, be complete.

Renton, Wash. FRANK W. HARRIS.

Engineering and the Popular Magazines

Sir—I have just returned from the service and have examined with considerable interest the numbers of *Engineering News-Record* issued during my absence, particularly those articles pertaining to education, reimbursement, and the status of the profession. Perhaps a word from a young member of the profession would not be amiss.

It is true, perhaps, that the engineering profession has been underpaid, and correspondents have called attention to the fact that routine work may be performed by men not having the broader training of the engineer. Yet today we are constantly reminded that men of technical training capable of performing administrative work are in demand. Montesquieu, the French essayist, divided mankind into three classes—briefly, the captains, the lieutenants and the privates. An engineer is a member either of the first or second class. That being the case, shall we not avail ourselves of this opportunity for which a technical training is so valuable? In this connection we may note that a principal failing of engineers is general lack of knowledge of business methods and conditions. Why not estimate our abilities, and if found deficient, promptly remedy the evil?

Respecting the status of the profession and engineering education: The April number of *Harper's Magazine* contains an article entitled "The Chemists of the Future," similar to one I have long hoped some able engineer would write for publication in a popular magazine. If the status of the profession is to be raised, why discuss it only in engineering periodicals? Ellwood Hendrick, author of this article, says: "There is, nevertheless, a journeyman side to chemistry, and I think we should prepare for it. . . . Such a career provides a fair living, and it is not more monotonous than keeping accounts. . . . If we have been trained as laboratory helpers, without the theory and vision of chemists, then that is what we shall remain. . . . Of course, men will call themselves what they please, we cannot legislate titles. But it seems to me of vital importance that only those students of today should become chemists who are properly equipped to meet the great responsibilities which are there to encounter. It is the coming profession."

The general public has as little exact knowledge of the chemist's scope as it has of the engineer's. Assuming this, Mr. Hendrick writes lucidly, tactfully, so that the layman readily grasps the point when he speaks of catalysis, colloids, osmosis, etc. Here is a nine-page article in a publication suitable for telling the intelligent public the generalities of the profession's work. Cannot a competent engineer follow this worthy example? Cannot the purpose of raising the status of the engineer be gained more efficiently and to a wider extent by articles in the current magazines rather than in engineering periodicals? It should be remembered that as a class those who employ engineers do not read our literature. One very ready method would be a series of articles in our local newspapers describing the work of the various departments of the city engineering department and the necessary qualifications of the employees.

One other point of note in the above-mentioned article is related to engineering: "Municipal wastes must be conserved. . . . There are places along the East River where the water is not changed by the tide, and its condition is already septic. . . . Conditions must be changed and it is the chemist alone who can change them."

Shall the chemist outrun the engineer?

Washington, D. C. CHARLES W. BARBER.

Should Spend $1,000,000 on Topographic Maps

An annual expenditure of $1,000,000 for the topographic mapping of the United States is justified, in the opinion of Franklin K. Lane, secretary of the interior, in a letter to M. O. Leighton, chairman of the National Service Committee of the Engineering Council. Mr. Leighton had written to the secretary calling attention to the essential relation of the topographic mapping of the country to good engineering and the economic development of our resources. In replying, Secretary Lane said that the Geological Survey now has available a trained personnel sufficient to permit a large expansion of the Government's activities in topographic surveys; a summer school was established by the Department of the Interior for training young engineers in military mapping and to furnish the Engineer Corps with officers for this specialized service. Most of the men so trained are now available to supplement the regular topographic force of the Geological Survey. Mr. Lane's letter continues as follows: "For this reason, an annual expenditure of $1,000,000 on the topographic map of the United States is now justified both by the public needs and the ability of this department to perform this work economically and effectively. In such a program it is hoped that the states might increase their coöperative contributions to $500,000, especially as the coöperation for the two years past was necessarily interrupted by the military mapping being largely confined to a few border states. I am told that in several states the officials are now urging the completion of the coöperative mapping of their states within the next few years. . . . My present purpose is to submit a supplemental estimate to the 66th Congress, as you suggest, increasing the appropriation for topographic work to $500,000. The support of this larger program by the Engineering Council, representing as it does the great national societies, will be appreciated."

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Telescopic Pipe Carries Steam Supply to Traveling Derrick

TO AVOID the difficulties attendant upon the use of steam hose for a track derrick whose travel was several hundred feet, the "shotgun feed" was applied by E. B. Van de Greyn, chief engineer of the Beaumont Shipbuilding and Dry Dock Co. The device consists of three long pieces of pipe of three different sizes. The smallest one was connected to the traveler. The next one received the smaller one and had a stuffing-box on the end. In the same way this medium-size pipe passed through a stuffing-box on the end of a larger pipe and telescoped into it. The largest pipe was stationary, being attached to the steam main from the power house. This arrangement was found entirely satisfactory, very little steam was lost, and, while the pipe was lined up carefully at first, it was found later that such care was not necessary. At the bottom of the derrick or tower a water trap was provided to dry the steam before it reached the engines. This would, of course, have been necessary with any such long line, without regard to the telescopic feature. J. W. Link is president and general manager of the Beaumont Shipbuilding and Dry Dock Company.

Other Articles in This Issue of Interest to Contractors:

Erecting Long-Span Roof Over Steel Mill by Rolling Trusses to Place — Page 898

Comparison of Short-Haul Truck and Rail Shipments — Page 903

New Classification Proposed for Rock to Be Excavated — Page 907

Low Labor Output in War Work Not Due to Cost-Plus Contract (Editorial Interview) — Page 909

Neurasthenia a Growing Disease in Engineering Work — Page 918

Compressed-Air Shortage Relieved by Waste-Prevention Campaign

SHORTAGE of compressed air became critical at the Fore River yard of the Bethlehem Shipbuilding Corporation, Ltd., a year and a half ago, just after production was sharply speeded up by the war demands. The period started with 150 to 160 riveting gangs, and in a few months this force had increased to 300 gangs. Even with the smaller number, however, the air was short, and often at 10 a.m. the pressure was down to 50 lb. A remarkably successful waste-prevention campaign was then inaugurated, and it solved the difficulty. The air consumption per gang was cut down to less than half, and the pressure was kept up to normal throughout the day.

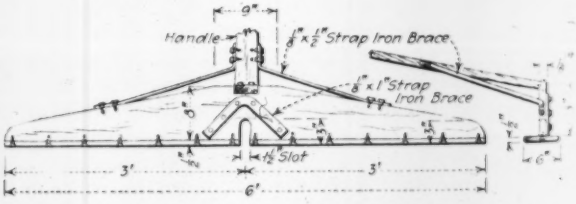
As soon as the shortage became critical, an investigation started by direction of the general manager, S. W. Wakeman, showed widespread evidences of leakage and waste. A 12-man patrol was sent out to stop leaks wherever found in the yard, and the shops were policed. The men of the patrols had orders to cut all leaky hose. Blowing snow off material by compressed air was also stopped. This positive work was aided by educational work through posters. In a short time the air consumption, which had run up to 60 cu.ft. per minute per riveting gang, was brought down to nearly 30, and then down to 25 or lower. On the biggest operating day, Aug. 1, 1918, there were 315 riveting gangs at work in the yard, which means several times that number of air tools in operation; yet the pressure was held up to 90 pounds. Addition of two 5000-cu.ft. electric compressors later increased the previous capacity of 12,600 cu.ft. per minute by displacement to a total of 23,600 cu.ft. Before the new machines were in, a 1000-ft. compressor was rented, and later two 1700-cu.ft. machines were borrowed from the equipment built for the new Squantum plant. Except for these two temporary additions, however, the old installation had to carry the load. A year ago the air consumption ran up to 11,000,000 cu.ft. in 24 hours, by piston displacement; the present consumption ranges from 8,000,000 to 9,000,000 cu.ft., in spite of a 50% increase in the number of gangs working. The following figures for three consecutive days, from a recent record sheet, are representative:

246 gangs, 26.61 cu.ft. per minute per gang, 9,000,000 cu.ft. displacement per 24 hours
247 gangs, 24.23 cu.ft. per minute per gang
253 gangs, 22.32 cu.ft. per minute per gang
273 gangs, 23.70 cu.ft. per minute per gang

Split Float for Finishing Concrete at Expansion Joints

FINISHING the surface of concrete pavement at transverse expansion joints (where the expansion material projects above the surface), in order to give a uniform elevation on each side of the joint is accomplished by means of the split float illustrated. While the use of split templets on concrete-road work is not new, the float shown has some features which are of value.

In the early days of concrete-road construction con-



SPLIT FLOAT OF SIMPLE CONSTRUCTION EFFECTIVE AT TRANSVERSE JOINTS

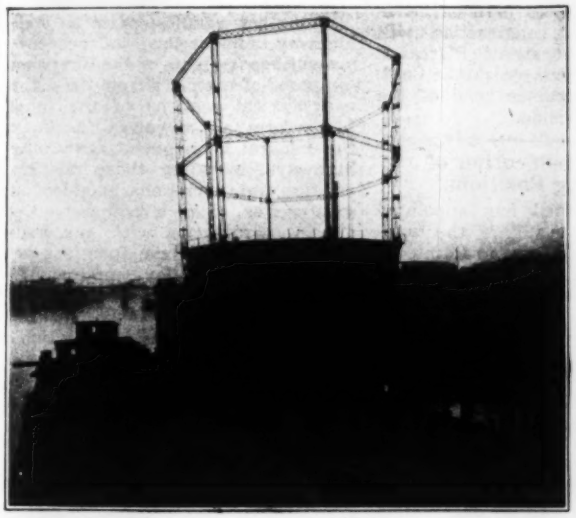
siderable trouble was experienced in making the adjoining slabs at the same elevation. The unevenness due to difference in elevation was disagreeable to traffic and caused excessive wear, often resulting in the destruction of the pavement. To overcome this, various methods, using split templets, etc., were devised; all of them required the finishing of the surface on the two sides of the joint independently. The device here described is so constructed that both surfaces may be floated at the same time, assuring uniformity.

The dimensions and construction of the float are clearly indicated by the illustration. In operation it is easy to tell at once where concrete should be removed or filled in adjacent to the joint, by the way the float rests on the surface. The slot is made to fit over the expansion joint as with the ordinary split straightedge, while the flat 6-in. board on the bottom floats the concrete to a perfect surface which is in the same plane on both sides of the joint.

This device, which was described in the *Concrete Highway Magazine*, was successfully used by the Connelly Construction Co. on the Bartlesville-Dewey road at Bartlesville, Okla.

Gas Container 70 Feet in Diameter Moved on Two Barges

THE gas container pictured herewith we recently moved a distance of 3 miles in Portland, Ore. It is 70 ft. in diameter and 75 ft. high, and weighs 300 tons. It was raised a distance of 15 ft. and loaded on rollers at Front and Everett Sts., then moved two blocks north



300-TON GAS CONTAINER BEING ROLLED ONTO BARGES FOR THREE-MILE VOYAGE

and two east, being lowered from the street to dock level, a distance of 28 ft. It was then rolled onto two barges lashed together, using hardwood rollers with block and tackle and a large gasoline engine. The barges were then towed three miles to the Northwest Steel Shipbuilding plant, where the tank was unloaded and raised 26 ft., moved across newly filled ground a distance of 2000 ft. (crossing a railroad track) and placed on its new foundation. The entire work required 71 days.

The tank was moved by Clay S. Morse, Inc., under the supervision of C. J. Disler, engineer of Le Doux & Le Doux, general contractors.

Pipe Line Lowered by Side Cuts Allowing Core to Squeeze Out

SINKING a 48-in. reinforced-concrete pipe line to grade by excavating along either side and allowing the triangular ridge or core to crush down under the weight of the pipe, was the method employed in lowering a part of the Signal Hill storm drain at Long Beach, Calif. About 300 ft. of pipe had floated above grade line in the 10-ft. trench, and backfilling was deposited before this condition was discovered, the maximum rise being about 14 inches.

In reopening the trench, excavation was carried down to 12 in. above the bottom of the pipe, and seepage water was then allowed to collect, the balance of the excavation being done under water. For this work the material was taken out only at the sides, the weight of the pipe, 900 lb. per linear foot, crushing down the ridge of soft, wet earth beneath it. The excavation was carried on in this way until the pipe had regained its original position. The advantage of this procedure was that the pipe was supported continuously and was lowered as a monolithic structure. Only one joint was damaged during the operation, but five had been cracked when the pipe rose.

Plans for the drain were prepared by R. V. Pearsall, of Long Beach, Calif., and James Kennedy, of Los Angeles, Calif., was the contractor.

Thaw Ice Cakes to Clear Foundation

ICE formation nearly 4 ft. thick piled up along the Mohawk River at the time when the General Electric Co. pumping station at Schenectady was built during the severe winter of 1917-18. The accompanying view shows how the contractor, Keith O. Guthrie, of Schenectady, got the impeding ice out of the way. The ice was first cut with steam jets, and pieces weighing several tons each were picked up with the nearby derrick and hoisted out of the way onto the adjoining bank.

40-INCH CAKES OF ICE CUT WITH STEAM PIPES

NEWS OF THE WEEK

New York, May 8, 1919

New York Public Service Commission Abolished

New State Law Establishes Two Independent Commissioners—Nixon Appointed, but Parsons Declines

With the signing of the Foley bill by Governor Smith of New York State May 3 the Public Service Commission (of the First District), which has been carrying on both regulation of utilities and construction of rapid-transit lines in New York City for 10 years, was abolished, and a single utility-regulation commission was established to take up its regulative work. Under another legislative bill, not yet signed, construction of rapid-transit lines is to be handled by a separate organization under a rapid-transit construction commissioner.

Immediately following his signing of the new public-service law, Governor Smith appointed Lewis Nixon, state superintendent of public works, as regulation commissioner for the city. Mr. Nixon, graduated from Annapolis in 1882, was a naval constructor for many years, and then established a shipyard at Elizabethport, N. J. Later he was chairman of the new East River Bridge Commission which built the Williamsburg bridge, and subsequently became Commissioner of Public Works and acting borough president of Richmond (Staten Island), New York City. He was appointed Superintendent of Public Works for the State of New York in January. His deputy, Edward F. Walsh, succeeds to this position.

Col. William Barclay Parsons, 11th Engineers, to whom Governor Smith some weeks ago offered the position of rapid-transit construction commissioner, to complete the proposed reorganization of the Public Service Commission, has declined to accept. Until a construction commissioner is named, Mr. Nixon will perform the duties of this office. Three members of the Public Service Commission of five were in service at the time when the commission's existence ended: Travis H. Whitney, acting chairman and formerly secretary of the commission; F. J. H. Kracke and Charles S. Hervey.

Extensive Changes of Personnel in Fleet Corporation

Important changes in the Emergency Fleet Corporation took effect May 1. Chief among them was the retirement of Charles Piez as director general and Howard Coonley, as vice-president in charge of administration. At the same time Admiral H. H. Rousseau, head of the shipyard plants division, Daniel H. Cox, head of the steel ship division, and four other division heads retired. Steel-ship construction will hereafter be in charge of Pierce J. McAuliffe, hitherto first assistant. Capt. R. N. Bakenhus becomes head of the shipyard plants division.

Employment Bureaus

Engineering Societies' Employment Bureau, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

Pay and Classification of Engineering Positions

Engineering Council has appointed a committee to investigate the compensation of engineers and to formulate a standard classification of engineering positions, with corresponding rates of compensation. The general committee is organized in sections, each of which has charge of a particular field of engineering work. The chairman of the general committee is Arthur F. Tuttle, deputy chief engineer of the Board of Estimate and Apportionment of New York City. Mr. Tuttle is also chairman of the municipal engineers' section. The chairman of the section which is to deal with engineers in the Federal Government service is John C. Hoyt, of Washington, D. C., hydraulic engineer of the United States Geological Survey. The chairman of the railway engineers' section is Francis Lee Stuart, consulting engineer, New York City, late advisory engineer to the Federal Railroad Administration. Each of these sectional committees is proceeding with investigations and obtaining from as wide a field as possible records of such classifications of engineering positions as are now in force, with the rates of compensation.

Chamber of Commerce For Federal Highways

Annual Meeting at St. Louis Also Passes Resolutions for Water-power Development

The Chamber of Commerce of the United States, at the annual meeting held in St. Louis Apr. 30, passed resolutions urging the creation of a Federal Highway Commission, and Federal appropriations for highways; development of waterways and water-power, and a resolution against Government operation and ownership of businesses which can be successfully undertaken and conducted by private enterprise.

The resolution regarding a national highway system states:

"That highways are an integral part of our nation's system of transportation has been emphasized by the war, and an enormous development is at hand, so important as to require a comprehensive national policy, under which Federal appropriations for highways will be applied to national needs for interstate commerce, agriculture, postal delivery, common defense and general welfare.

"Congress should create a Federal highway commission, independent of present departments of the Government, composed of members from the different geographical sections of the country, to perform all executive functions of the Federal Government pertaining to highways, including those relating to existing appropriations in aid of state construction. Such a commission should act in coördination with any Federal agency that may have functions of articulating rail, trolley, water and highway transportation.

"Congress should make substantial appropriations for the construction and maintenance of a national highway system to serve the need for the maintenance of interstate travel and traffic.

"The commission should report to Congress a plan for continued aid for state construction of highways in the period beyond 1921, to which time the provisions of existing Federal-aid laws extend.

"Expenditures of funds should be permitted only for highways which are of a permanent type, having thorough drainage, substantial foundations, sufficient width and a capacity for traffic which will be reasonably adequate for future needs."

Another resolution favored the speedy completion of river improvements and water-way projects already authorized by Federal laws, and another the "true conservation of the water-power resources of the United States."

The resolution regarding Government

operation and ownership is as follows:

"The very essence of civilization is that there be placed upon the individual only that degree of restraint which shall prevent his encroachment upon the rights of others, thus realizing to the utmost individual initiative in every proper direction. Our form of government most effectively expresses and maintains this principle. Within our basic law exists ample provision for such changes as may, from time to time, be necessary to safeguard our people.

"It is therefore essential that our Government should scrupulously refrain from entering any of the fields of transportation, communication, industry, and commerce, or any phase of business when it can be successfully undertaken and conducted by private enterprise. Any tendency of Government to enter such fields should be carefully weighed in the light of its possible effect upon the genius of our Constitution."

Extensive Ship Cancellations to Readjust Program

In addition to 2,000,000 tons of steel ships the contracts for which have been cancelled since last November by the Shipping Board, 2,000,000 tons more are now being cancelled, according to a statement by Edward N. Hurley, chairman of the board. No details are given as to the sizes of ships and the yards affected. The statement refers to the necessity of balancing the fleet and also to the war prices of the contracts. Chairman Hurley says, "We feel that we should now be building only at peace prices," and states that the cancellation of all existing contracts is under contemplation, where keels have not actually been laid. This statement, issued from the Shipping Board office Apr. 25, is amplified and somewhat changed by a statement issued May 5. According to the latter, the type of vessel that will be most largely needed for post-war ocean carriage is a combined freight and passenger vessel of at least 12,000 to 15,000 tons dead weight carrying capacity, and the cancellations are to be made with a view to preparing for placing orders for this type of ship.

Plant-Disposal Section Created To Sell Shipyards

Preparing to put on the market the Emergency Fleet Corporation's interests in shipyards and ship-fabricating plants, the Director General has established a plant disposal section of the corporation, in charge of B. E. Grant, hitherto engineer of the shipyard plants division. Property totaling several hundred million dollars in value is involved, and it is desired to put these great interests into private hands as going concerns. It is stated that the corporation already has an offer from one of the Southern concrete yards to take over the yard, with a view to building a concrete dry dock.

11th Engineers Parade in New York

Unit That Held Germans Before Amiens Marches Down Fifth Avenue Soon After Arrival

The 11th Engineers of the United States Army, the unit that held the Germans before Amiens a year ago last March, paraded down Fifth Avenue, New York City, Apr. 30, led by its commander, Col. William Barclay Parsons, a few days after the regiment's arrival at the port of debarkation at Hoboken, N. J. Thirteen hundred of these men, who had served overseas for 22 months, marched between cheering crowds along Fifth Avenue from 96th St. to 34th Street.

Col. William Barclay Parsons marched with his staff at the head of his command. He was accompanied by Lieut. Col. William T. Chevalier. Maj. Charles D. Drew led the first battalion and Maj. B. A. Value the second. In the official reviewing stand, opposite 82nd St., were Governor Smith, Mayor Hylan, Deputy Police Commissioner Rodman Wanamaker, Brig. Gen. F. V. Abbott, and Maj. Gen. D. C. Shanks, in charge of the port of debarkation at Hoboken.

At 34th St. the regiment swung off the avenue and proceeded to the Pennsylvania Hotel, where a dinner tendered by the Military Engineering Society was served. J. Waldo Smith, chief engineer of the Board of Water Supply, City of New York, and chairman of the Committee of Welcome of the Military Engineering Society, introduced Colonel Parsons, who spoke of the pride of the engineering profession in the deeds of his men. Colonel Parsons declared that two things in the regiment's war career had almost escaped the notice of the public.

"A year ago last March," he said, "when the Germans began their great offensive, flinging masses of men between the British and French line, which bent and fell back, but—thank God!—never broke, and when General Pershing was told that two regiments of engineers were needed at the very front, there was never any question about the first regiment chosen—it was the 11th. They thought for some time before selecting the second regiment.

"The other thing is the rise of the enlisted men. Sixty-eight became commissioned officers during the war."

Free Service Bureau of Contractors' Association

In the interest of obtaining competent general contractors' employees, the Associated General Contractors of America have established a free service clearing house for members. G. W. Buchholz, acting secretary, 111 W. Washington St., Chicago, has issued a call as follows:

"Whenever you are obliged to dispense with the services of a general foreman, superintendent, engineer, estimator, bookkeeper, or any other employee whom you consider worthy, send his name and address to this office, with a short description of his abilities and past record, salary that you have been paying him, whether he is married or not, and if he is willing to go to any part of the country. If you contemplate increasing your force in any way, notify this office, stating the type of employee you desire, approximately what his duties will be, and the amount of salary you expect to pay."

National Conference on Training for Commercial Engineering

A national conference on "Business Training for Engineers and Engineering Training for Business Men" will be held in Washington, D. C., June 23-24. This conference is called by Commissioner of Education Claxton on behalf of a conference committee on commercial engineering recently created by the Department of Education. Representatives of all general interests, all educational institutions, commercial organizations, and engineering societies will be invited to participate.

Active Discussion Expected at A. S. T. M. Meeting

Unusually active discussion of test methods and results will mark the 1919 meeting of the American Society for Testing Materials, according to present indications. While committee reports will be less extensive than in normal years, and it is likely that only one or two new specifications will be presented, the program of papers will be of exceptional character. A topical discussion of "Magnetic Analysis of Steel" is to be made a prominent feature. The meeting will be held at the Hotel Traymore, Atlantic City, N. J., June 24-27.

In the field of iron and steel, a subject of special importance at present will be covered by a paper on "Deep Etching of Rails and Forgings," by K. E. Hofammann and F. M. Waring. Other important papers are: "Modern High-Speed Steel," by J. A. Mathews; "Some Fatigue Tests of Nickel Steel and Chrome-Nickel Steel," by H. F. Moore and A. G. Gehrig, and "The Influence of Very Low Percentages of Copper in Retarding the Corrosion of Steel," by D. M. Buck. The discussion of magnetic analysis will be opened by five papers, including among other things the application of the method to ball-bearing races, rifle-barrel steel and railroad rails. In nonferrous metals, season-cracking of wrought manganese bronze will be further discussed by P. D. Merica and R. W. Woodward.

Half a dozen papers on cement and concrete of an unusual degree of interest are to be presented. They include "Theoretical Studies of the Surface-Area Method of Proportioning as Applied to Concrete," by R. B. Young; "Proportioning of Pit-Run Gravel for Concrete," by R. W. Crum; "Modulus of Elasticity of Concrete," by Stanton Walker; "Effect of Fine-

ness of Cement," by D. A. Abrams, and "Cements Producing Quick-Hardening Concrete," by P. H. Bates. Instruments will be dealt with in papers on "The Strainagraph and Its Application to Concrete Ships," by F. R. McMillan; "A Fatigue-Testing Machine," by F. N. Farmer, and "A Machine for Measuring Hardness of Thin Metal Sheets," by S. L. Goodale. In the field of preservative coatings a new view of the subject will be presented under the title of "Paint a Plastic Material and Not a Viscous Liquid; The Measurement of Its Mobility and Yield Value," by E. C. Bingham and Henry Green. A number of more specialized papers are on the program.

The evening session of June 24 will be a memorial session for Dr. Edgar Marburg, late secretary of the society. President G. H. Clamer, Provost Edgar F. Smith, John M. Goodell, Robert W. Leslie, Arthur N. Talbot and Robert W. Hunt will speak of Dr. Marburg's activities and his work for the society.

To Retire as Secretary of Municipal League

Clinton Rogers Woodruff, for the past 25 years secretary of the National Municipal League, has announced in a letter to Lawson Purdy, president of the league, that he will not be a candidate for reëlection. Mr. Woodruff expects to devote his entire time to the practice of law. In part, Mr. Woodruff's letter to Mr. Purdy follows:

"On May 28 next I shall have completed 25 years of service as secretary of the National Municipal League. Elected at the first meeting held in New York City, I have served continuously ever since. During this period the movement for higher municipal standards and democratic city government has developed to a point where a larger share of my time and attention is required than my other interests will permit me to give. I am therefore reluctantly forced to the conclusion that I must retire, so I hereby give notice that I shall not be a candidate for reëlection to my present position."

Kansas City Viaduct Contract Let to Low Bidder

Settlement of the controversy over the contract for building the Twenty-third St. Trafficway, Kansas City, has been reached by letting the contract to the low bidder, the A. S. Hecker Co., of Cleveland, after the latter agreed to guarantee that the cost should not exceed its estimate. As noted in these columns four weeks ago (p. 743), the city council refused to award the contract to the Hecker company, and asserted that the cost-plus form of contract did not protect the city. In its final form the contract provides a fixed maximum price of $716,000 for the work; the city shares equally with the contractor in any reduction of cost below its estimate of $666,000.

Program of National Traffic Association Meeting

The annual meeting of the National Highway Traffic Association will be held at the Automobile Club of America, 247 W. 54th St., New York City, May 14. Among the speakers and their subjects are the following:

Afternoon session, 2:30 p.m., "Development of Rural Motor Express Throughout the United States," by F. W. Fenn, secretary of the motor truck committee, National Automobile Chamber of Commerce; "Transportation Surveys for Rural Motor Express Routes," by J. H. Collins, member of the highway transport committee, Council of National Defense; "Wanted, Rural Motor Express in the State of New York," by James E. Boyle, extension professor of rural economy, Cornell University; "Signposting for Through Routes in Municipalities, and Detours During Highway Construction," by Elmer Thompson, secretary of the Automobile Club of America.

Evening session, 8 p.m., presidential address, "Highway Transport Engineering" (illustrated), by Arthur H. Blanchard; "The Townsend Highway Bill and the Work of the Federal Highway Council," by H. G. Shirley, secretary of the Federal Highway Council; "Highway Requirements for Twentieth-Century Transportation," by W. G. Thompson, state highway engineer of New Jersey; "The Control of Traffic on Feeder Highways," by Edward J. Mehren, editor of *Engineering News-Record*, George H. Pride, president of the Heavy Haulage Co., and George M. Graham, manager, Pierce-Arrow Motor Car Co. The first motion picture created to show the high cost of bad roads and the advantage of motor transport, entitled "The Open Road to a Greater America," will be shown by the educational department of the Universal Film Mfg. Company.

Motor Truck Impact Tests Made By Bureau of Public Roads

Tests of importance to road builders, automobile builders, state authorities in control of speed laws, etc., were made May 5 by engineers connected with the Bureau of Public Roads of the Department of Agriculture on roads just outside of Washington, D. C. For the first time, a direct measurement of the impact of trucks on roads was made. The engineers mentioned have invented a system to measure this impact by the compression of a copper cylinder set in a chamber in the road, which is similar to the system used to measure the explosion in a rifled gun.

The device, which is the invention of Prevost Hubbard and A. T. Goldbeck, was tested on the roads of the agricultural experimental farm on the Potomac River in Virginia, in the presence of the designers, and of T. H. MacDonald, the new engineer in charge of Federal-aid roads, as well as John M. Goodell, F. H. Jackson and A. T. Smith, all connected with the Bureau of Public Roads, and the Washington representative of *Engineering News-Record*.

Details of the results have not yet been tabulated. The engineers expect to be able to announce results which will be of importance to road builders, automobile tire builders, and others.

Some Highway Engineers Coming Home

The War Department announces, in accordance with a cablegram received from General Pershing, that a few units of the 23rd Engineers have been assigned to early convoy for return to the United States from France. The units so far scheduled to come home are the fourth battalion, the wagon-train headquarters and wagon companies Nos. 1, 2, 3, 4 and 5. No information is obtainable, according to the Washington correspondent of *Engineering News-Record*, as to when the remainder of the 23rd Engineers is to return, but it is believed in Washington that the conferences which Secretary Baker had with General Pershing while in France have influenced the decision to return some of the highway engineers at this time, and it is hoped that the remainder of the regiment will be back before the road-building season is over. It is stated in Washington that other engineering units are now being scheduled for early return. Announcements as to the return of other engineering units may be expected in cablegrams from General Pershing from day to day from now on.

Proposed Legislation in Illinois to Develop 40,000 Kilowatts

The water-way scheme which has passed the senate of Illinois and which will provide a transportation waterway from Chicago to down-state and Mississippi River points, contemplates the removal of a dam in the Desplaines River at Joliet, and the construction of a modern 40,000-kw. power plant four miles farther south at a site known as Brandon's Road. At the same time, there is in the legislature a bill which will enable the Sanitary District of Chicago to bid on the power from this site, either developed or undeveloped. Should the bill pass in its present form it would enable the Sanitary District to bid not only on the new power at Brandon's Road, but also on the power from the old site, which has been the cause of so much court action in which the Economy Light & Power Co. was an interested party.

Civil Service Examinations

New York.—Junior assistant engineer, State Engineer and Highway Department, $1200-$1440 per year. May 24. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

New York.—Bridge designer, Public Service Commission, First District. $1501 to $2100 per year. Apply to

State Civil Service Commission, Albany, N. Y. File applications before May 24.

For United States civil service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Highway bridge engineer, $1800 to $2100 per year, junior highway bridge engineer, $1200 to $1600 per year, Bureau of Public Roads and Rural Engineering, May 21. File applications in time to arrange for examination at place selected by applicant.

Engineer in forest products, $1860-$3000 per year; assistant engineer in forest products, $1200-$1800 per year, Forest Products Laboratory, Madison, Wis., May 27. File applications before May 27.

Chief of road survey party, $1800 to $2100 per year, transitman for road surveys, $1200 to $1800 per year, highway draftsman, $1200 to $1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

Senior engineer and senior architect, Interstate Commerce Commission, $1800-$2700 per year, June 10. File application before June 10.

Assistant material engineer, Bureau of Construction and Repair, from $4.48 to $6.40 and upwards per diem. No date specified. Applications should be filed without delay.

Valuation engineer, $3600-$4800 per year, and assistant valuation engineer, $2500-$3600 per year, technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 12-13, Chicago.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 29 W. 39th St., New York; May 16, New York.

NATIONAL CONFERENCE ON CITY PLANNING; 19 Congress St., Boston; May 26-28, Niagara Falls and Buffalo.

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 9-13, Buffalo, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39th St., New York; June 16-19, Detroit.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

ENGINEERING SOCIETIES

The Southwest Water-Works Association will hold its annual convention in Kansas City, Mo., June 23-26. A feature of the convention will be "round table talks," at which water-works engineers and superintendents will be given an opportunity to speak briefly on various problems with which they have recently been confronted.

The American Association of Engineers will discuss the following subjects at the annual meeting May 12-13 in Chicago: "Relation of Other Societies to the A. A. E., Local, State and National Societies, Engineering Council, Engineering Institute of Canada"; "Relation of Engineers to Each Other in Employment"; "Relation of Engineering Organizations to Engineering Education"; "Recognition of Engineers through Proper Compensation and Through Self-Improvement and Service"; "How Far Will A. A. E. Go Into Politics?" To "Employment Department, New Fields and Opportunities" will be devoted a whole session. Col. Walter Dill Scott will speak on "Fitting the Engineer to His Job."

The Tidewater Virginia Technical Engineers is the name adopted for the new society organized at Norfolk, Apr. 23, at a meeting of local engineers. The following officers were elected: President, Capt. Whit. P. Tunstall; vice-presidents, W. B. Bates and John F. Benson; secretary, R. W. Bonney; assistant secretary, R. Johnson Neely, and treasurer, G. Hubbard Massey. The new organization has about 100 members. The intention is announced of becoming a chapter of the American Association of Engineers.

The Canadian Military and Civil Engineers' Association has been formed by officers of engineering units of the Canadian Expeditionary Forces, according to a statement made by Maj. F. J. O'Leary, late brigade major, First Canadian Divisional Engineers, who recently arrived from France. The object of the association is announced to be to protect the interests of its members regarding pensions, war-service gratuities and civil reëstablishment, as well as rendering financial assistance where required. The officers, elected in France, include the following: Gen. Sir A. C. MacDonnell, Col. A. McPhail, Lieut. Col. J. M. Rolston, and Lieut. Col. E. Peppler.

The Detroit Engineering Society held a joint meeting May 1 with the Detroit-Ann Arbor Section of the American Institute of Electrical Engineers, at which A. A. Oswald, research engineer, Western Electric Co., New York, spoke on "Wireless Telephony and Telegraphy in War." A regular meeting of the society was held May 2, which was addressed by John L. Harper, chief engineer, Niagara Falls Power Co., who spoke on "The Past and Prospective Power Development at Niagara Falls and Hydraulic Problems Connected Therewith."

The Utah Society of Engineers held a meeting Apr. 23 devoted to a discussion of the engineering phases of the production of sugar. The following papers were presented: "Mechanical Operation of Factory," by W. Y. Cannon, assistant consulting engineer, Utah-Idaho Sugar Co.; "Process and Chemical Control," by B. R. Smoot, assistant general superintendent, Utah-Idaho Sugar Co.; "Design of Factory" by A. P. Cooper, consulting engineer; "Byproducts" by Mark Austin, general agriculturist, Utah-Idaho Sugar Co.

The Engineers' Club, of Columbus, Ohio, will open its new club rooms May 15. A reception will be held to mark the event. The new officers to be installed May 15 are: President, J. J. Morgan; vice-presidents, J. E. Payne and J. R. Withrow; secretary, Arthur Richards, and treasurer, T. H. Brannan. The retiring president and secretary are, respectively, E. G. Bradbury and Clyde T. Morris.

The Omaha Chapter of the American Association of Engineers recently elected the following officers: President, W. R. McKeen, president of the McKeen Motor Car Co.; vice-presidents, J. R. Houghton and J. A. Bruce; secretary, E. Trimble, construction equipment contract department, Union Pacific Co.; and treasurer, W. J. F. Sackriede.

The Municipal Section of the St. Loius Chapter of the American Association of Engineers has been organized with the following officers: E. Paffrath, chairman, and George Grimm, Jr., secretary. One vice-chairman will be elected from each of the five city departments.

The Engineers' Club of Philadelphia held a joint meeting May 6 with the Philadelphia Association of Members of the American Society of Civil Engineers, at which George W. Fuller, consulting engineer, New York City, spoke on the "Coming Duties and Opportunities of Engineers." The annual meeting of the club will be held May 20. The subject of the annual presidential address, by the retiring president, J. Franklin Stevens, will be "The Engineers' Club; Retrospect and Prospect." Following the presidential address Jamison Handy, vice-president of the Bray Studios, Inc., will deliver a paper, illustrated with motion pictures, on "The Motion Picture's Un-

known Part in Winning the War," treating of the secret use of motion pictures during the war for instruction and other uses. The weekly luncheon of the club, May 6, was addressed by Capt. C. J. Clarke, U. S. A., who spoke on "The Relationship of the Wounded Soldier to Business," and the meeting on May 13 will be addressed by Maj. J. A. Vogleson, U. S. A., who will speak on "Camp Sanitation."

The Dayton, Ohio, Chapter of the American Association of Engineers recently elected the following officers: President, E. J. Correll; vice-president, G. Calvert; secretary, H. Gellin; financial secretary, L. Born, and treasurer, L. E. Ettinger.

The Twin City Chapter of the American Association of Engineers elected the following officers at the recent annual meeting: President, Frederick K. Bennett; vice-presidents, W. B. Irwin and A. V. Duncanson; secretary, R. C. Smith; treasurer, E. M. Bolmgren.

The Rochester, N. Y., Engineering Society held a meeting May 7 which was addressed by Maj. John F. Coneybear, Ordnance Department, U. S. A., who spoke on "Machine Guns." A meeting will be held May 9 at which Charles C. Zoller will be the speaker.

PERSONAL NOTES

WALTER A. FISCHER, formerly designing and constructing engineer on water-works and hydro-electric plants in California and New Mexico, and more recently hydraulic engineer, Construction Division, U. S. A., has been appointed advisory engineer for water supply, Construction Division of the Army, succeeding Lieut. Col. Dabney H. Maury.

CAPT. LOUIS D. KOOP, 211th Engineers, U. S. A., who recently received his discharge from the service, has been appointed chief engineer, Mark C. Tredennick Co., builders, New York City. Captain Koop also served with the 102d Engineers and was constructing quartermaster at Camp Wadsworth, South Carolina.

HENRY C. MEYER, JR., WILLIAM E. S. STRONG, and BASSETT JONES have become associated under the firm name of MEYER, STRONG & JONES, INC., consulting engineers, with offices at 101 Park Ave., New York City, and will specialize in power plants, and mechanical and electrical equipment of buildings and industrial establishments.

RODMAN M. BROWN, chief engineer, city building department of Omaha, has resigned to become general manager, Stiles Construction Co., now engaged in the erection of the Western Motor Car Co.'s new building. It is announced that the Stiles company will open a permanent office in Omaha.

W. R. ARMSTRONG, engineer maintenance of way, Union Pacific System and St. Joseph & Grand Island Ry., has been appointed assistant chief engineer, with jurisdiction as well in the Oregon Short Line, Los Angeles & Salt Lake R.R. His headquarters are in Salt Lake City. Mr. Armstrong was born in 1869 and was graduated from Kansas State University in 1890. His first railroad experience was with the Kansas City, Pittsburgh & Gulf R.R. (now the Kansas City Southern Ry.) in location work, and he afterward became division engineer. After nearly 14 years' experience in engineering and operating departments on various railroads, Mr. Armstrong went to the Oregon Short Line in 1905. He was employed on special engineering work during his first year with that company, and later had charge of construction of the Yellowstone Park branch and of the line from Huntington to Homestead, Ore. He later became superintendent of the mountain division and was appointed chief engineer and general manager in 1913. In 1916 he was appointed engineer maintenance of way, Union Pacific System.

KARL R. KENNISON has been transferred from the middle Atlantic district, United States Shipping Board, Emergency Fleet Corporation, at Baltimore, to the Southern district, where he has been appointed assistant district plant engineer, with headquarters in New Orleans.

MAJ. H. J. BURT, Construction Division, U. S. A., who for the past 18 months has been expediting officer, engineering branch of the Construction Division, has received his discharge from the service and has resumed his association with HOLABIRD & ROCHE, Chicago, as manager.

MAJ. ALLAN M. JACKSON, Canadian Engineers, who has just returned from two years' service overseas, has been appointed chief engineer and superintendent of construction for the Brant County, Ontario, highway system.

FRED R. WHITE, head of the road department, Iowa State Highway Commission, since 1915, has been appointed chief engineer of the State Highway Commission, succeeding T. H. MacDonald, whose appointment as engineer of the Federal-aid road act was noted in *Engineering News-Record* of Apr. 3, 1919, p. 689. He was born in 1884 and was graduated from Iowa State College in the civil-engineering course in 1907. His first engineering work was with the Florida East Coast R.R., on the construction of the Long Key viaduct. He entered the service of the Iowa State Highway Commission in 1908, two years later becoming associated with the Morgan Engineering Co. In 1911 he returned to Iowa and engaged in bridge-construction work for Cerro Gordo County, afterward entering the service of the State Highway Commission as field engineer.

CHARLES F. WILSON, for several years deputy city engineer, Yakima, Wash., has been appointed city engineer, succeeding N. A. Gilman, whose resignation was noted in *Engineering News-Record* of Apr. 10, 1919, p. 747. C. DE VERE FAIRCHILD has been appointed deputy city engineer.

WILLIAM H. ADAMS and ROBERT J. CUMMINS have dissolved the partnership of ADAMS & CUMMINS, consulting engineers, Detroit and Houston, Tex. The Northern business of the firm, with headquarters in Detroit, will be continued by Mr. Adams, and the Southern business, with headquarters in Houston, by Mr. Cummins.

CLEMENT A. HARDY, who for some years has been in the sales department of the Whiting Foundry Equipment Co., Harvey, Ill., has engaged in private practice as a consulting engineer, specializing in industrial-plant layouts, with offices in Chicago.

R. B. ROBINSON, engineer maintenance of way, Oregon Short Line, with headquarters at Pocatello, Idaho, has been appointed engineer maintenance of way, Union Pacific System and the St. Joseph & Grand Island Ry., succeeding W. R. Armstrong, appointed assistant chief engineer, as noted elsewhere.

CAPT. HARRY P. LETTON, Engineers, U. S. A., who was recently discharged from the service after 14 months with the Expeditionary Forces, largely in the water-supply service, has become associated in partnership with GRANT & FULTON, engineers, Lincoln, Neb., under the firm name of GRANT, FULTON & LETTON.

E. V. WILLARD, acting state drainage engineer of Minnesota, has been appointed commissioner of drainage and waters under the new drainage laws abolishing the state drainage commission and creating the position of commissioner.

EDMUND P. BURKE, who during the war was cost engineer, Engineering Division, United States Housing Corporation, has opened offices in the Kresge Building, Detroit, to engage in general engineering practice.

WILLIAM J. NORTON, of NORTON, BIRD & WHITMAN, has completed his work as general superintendent of the Aberdeen Proving Grond contract of the Maryland Dredging & Contracting Co., and has opened offices in New York City, in addition to those in Chicago, Baltimore and Boston. He will resume his consulting work on utility rate regulation problems. In association with

the Withington-Roberts-Wrights Co., Cleveland, industrial architects and engineers, he will engage in general industrial engineering.

L. W. HELMREICH, assistant engineer, Missouri Public Utilities Commission, has been appointed engineer of the recently organized Arkansas Corporation Commission, which will have under its jurisdiction the general supervision of public utilities operating within the state.

SYDNEY W. TAYLOR, JR., civil engineer, San Francisco, who during the war served as secretary of the Capital Issues Committees for the 12th Federal District, has resumed his practice, having opened an office in San Francisco.

HARRY C. COONS, assistant engineer, Eastern Washtenaw Good Roads District, Michigan, has resigned to become district engineer, Michigan State Highway Department, with headquarters at Farmington.

LIEUT. COL. DEWITT P. OLSON, Engineers, U. S. A., who since his return from France has been engaged as military instructor, Iowa State Agricultural College, has been appointed state highway engineer of Idaho, succeeding H. C. Allen, resigned.

CAPT. C. T. BISSELL, Construction Division, U. S. A., has received his discharge from the service and has returned to his former position as engineer, National Board of Fire Underwriters, with office in New York City.

J. J. COAN and EDWARD M. FULLER have become associated under the firm name of COAN & FULLER, engineers and contractors, Salt Lake City, Utah. Mr. Fuller recently resigned as construction engineer of the Utah Fuel Company.

VICTOR MAYPER, who recently has been engaged in Government work in Cuba and Panama, has returned and has opened offices for the practice of engineering at 15 E. 40th St., New York City.

MAJ. MYRON S. FALK, formerly chief, Raw Materials Branch, Explosives, Chemicals and Loading Division, has been promoted to the grade of lieutenant colonel, assigned to the Nitrate Division, Ordnance Department.

H. A. SEWELL, HANS STRASLSUND and C. W. STRAIGHT have organized the Interstate Engineering & Construction Co. with headquarters at Newport, Wash., and will engage in engineering construction.

FRANCIS E. DANIELS, Sanitary Corps, U. S. A., who acted as camp sanitary engineer, Camp Lee, Virginia, has received his discharge from the service and returned to the engineering division of the Pennsylvania State Department of Health, with office at Harrisburg.

HARLAND BARTHOLOMEW, consulting engineer, St. Louis, has been formally retained as consulting engineer for the City Planning Commission of Omaha.

CAPT. MAURICE R. SCHARFF, Engineers, U. S. A., who recently received his discharge from the service, has returned to his former work as principal assistant engineer, Morris Knowles, Inc., engineers, Pittsburgh.

DAVID A. MCCLOSKEY, formerly assistant engineer to the State Engineer, District No. 6, Pennsylvania Department of Highways, has been appointed engineer of Blair County.

R. T. SMITH, formerly of Temple, Tex., has been appointed city engineer and superintendent of water-works at Waxahatchie, Tex.

J. LEE PLUMMER, JR., and LEWIS R. OWEN have become associated under the firm name of OWEN & PLUMMER, civil engineers, Johnstown, Penn.

D. L. MCLEAN, district engineer at Shoal Lake for the Greater Winnipeg Water District, has been appointed office engineer, Manitoba Drainage Commission.

C. B. MCCULLOUGH, professor of civil engineering, Oregon Agricultural College, Corvallis, has been appointed state highway bridge engineer.

E. G. ATKINSON has been appointed assistant city engineer of Schenectady, N. Y.

ARTHUR FRANK, previously connected with the engineering department of the Excelsior Machine Co., St. Louis, has joined the engineering staff of the P. E. Gray Construction Co., Tulsa, Okla.

R. H. PENNORTZ, assistant engineer, Kansas Highway Commission, has resigned to become Oklahoma representative for the Barrett Co., New York City.

VINCENT G. SHINKLE has become a member of the firm, F. W. FREEBORN ENGINEERING CO., Tulsa, Okla., specialists in valuation of oil and gas properties.

J. E. JELLICK, senior resident engineer, Los Angeles County, California, Road Department, has been appointed division engineer, Wyoming State Highway Commission.

R. W. SPOFFORD, who was placed on the retired list of the Navy after the armistice, has returned to the J. G. White Management Corporation, New York City, and has been appointed general manager of the Manila Electric Railway & Light Co., Manila, P. I., for which the White corporation acts as operating manager.

HENRY S. EVANS, formerly of the firm of Evans & Evans, engineers, Altoona, Penn., has been appointed general manager of the Engineering Service Co., Inc., Johnstown, Penn.

R. O. RENSHAW, Huntington, W. Va., has been appointed county engineer of Ritchie County.

JOHN C. BAGLEY, state fire prevention engineer of Indiana, has resigned to become sales manager of the Obenchain-Boyer Co., Logansport, Ind.

E. J. UMSTEAD, formerly chief draftsman, mechanical division, Bureau of Water Supply, Pittsburgh, has been promoted to division engineer.

E. DRINKWATER, consulting engineer, Montreal, Can., has removed his Montreal South office to Rooms 212-13, 180 St. James St., Montreal.

EDWARD J. SMITH, hydraulic engineer, New York City, has established offices in El Paso, Tex., located in Rooms 812-13, Mills Building.

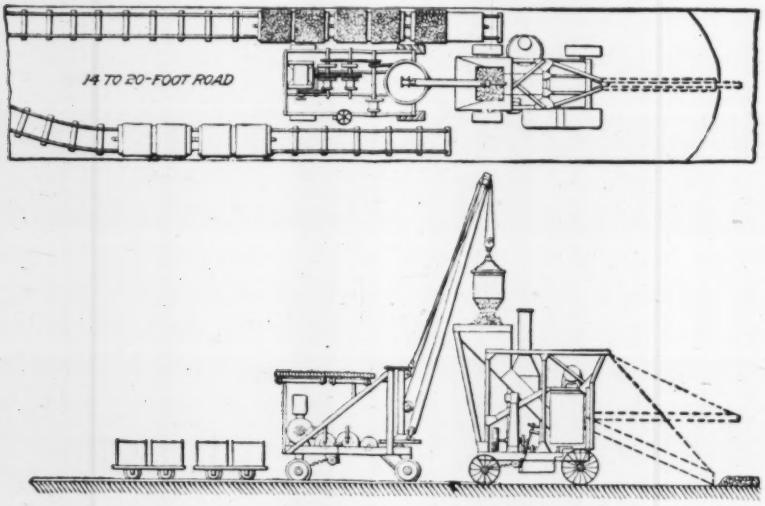
OBITUARY

HERMANN SCHUSSLER, for nearly 50 years engineer for the Spring Valley Water Co., of San Francisco, died in that city Apr. 27, at the age of 76. He entered the company's service in 1866 and remained in its employ as chief engineer until 1909. During this period he designed and constructed the company's entire system, including a large, concrete, subterranean filter-gallery system in Alameda County, Crystal Springs, San Andreas and Pilarcitos dams (San Mateo County), the conduit system conveying the water to San Francisco, and the distributing system in San Francisco. In 1909 he resigned as chief engineer to devote more time to his private practice. In his private practice as civil and hydraulic engineer he was identified with a number of works in California, Oregon, Nevada and Hawaii, and in a consulting capacity made numerous investigations, report and plans on development work in California. Mr. Schussler was consulting engineer for the California-Oregon Power Co. at the time when the Copco dam was built.

MAJ. JOHN WILLIAM MARK, 302nd Engineers, U. S. A., who since his return from France had been attached to the Engineer Officers' Training School at Camp A. A. Humphreys, Virginia, died in New York City May 2.

Self-Propelled Crane for Charging Concrete Mixer

A self-propelled crane for transferring "batch" hoppers from industrial railway cars to the charging hoppers of concrete mixers is being manufactured by the John F. Byers Machine Co., of Ravenna, Ohio. A similar device is



PLANT LAYOUT USING SELF-PROPELLED CRANE FOR CHARGING MIXER

used with steam power and a longer boom with clam attachment, for unloading and transferring aggregates from cars to the bins at the siding.

The layout for using the crane in connection with a concrete mixer is shown in the accompanying illustration. The crane carriage is of such width that it can operate upon a 14-ft. roadbed with a line of industrial track on each side. The crane is equipped with two friction drums, a forward and reverse propelling mechanism, a boom swinger and a bull wheel. The power is supplied by a 10-hp. gasoline engine. The capacity of the crane is two tons at a 10-ft. radius. While this machine may be used with the ordinary hoist-hopper mixer, the drawing shows a combination which, it is asserted, saves 25% on first cost of mixer and about 10 sec. on each batch, by dumping directly into the mixer drum.

Wide wheels are used so that the apparatus can move easily over the subgrade. It is said that this device will overcome many of the difficulties which have attended feeding concrete mixers from industrial railways by a derrick attached to the mixer.

Purify Water in Large Swimming Pool by Ozonization

Purification of the water in what is said to be the largest swimming pool in the world, in New Krug Park, Omaha, Neb., will be accomplished by what is known as ozonization by the Ozone Co. of America, according to reports of the contract. The pool has a water surface area of more than an acre and holds 1,000,000 gallons of water.

Trade Organizations Begin Work on National Association Building

During the present week, work was started upon a building which it is planned to make the national home for all trade associations now located, or which will locate in the future, in New York City. Among the advantages which are expected from this plan are: Closer coöperation between allied industries; greater convenience for business men desiring to see several associations; special advantages for coöperative meeting rooms, and added prestige due to having a high-grade building devoted to the interests of business men, in the heart of the hotel, railroad and subway terminal districts of New York.

The building will be near the corner of Fifth Ave. and 43d St., extending through the block to 44th St. It will be 20 stories high, having about 275,000 sq.ft. of floor space, and will be terraced above the 12th floor to conform to the New York zoning law for conservation of light. An arcade with display rooms will extend through from 43d St. to 44th St. It is the first large business building enterprise started in New York since the armistice was signed. The contract was let to Fred T. Ley & Company.

The name of the structure will be the National Association Building. It will be ready for occupancy the latter part of next January. Further information may be obtained by addressing Willard C. Brinton, consulting engineer, 17 W. 44th St., New York City.

Railroad Administration Purchases 2,000,000 Ties

Through L. S. Carroll, chairman of the purchasing department of the United States Railroad Administration, the Pacific Coast fir lumbermen have received an order for 2,000,000 railroad ties, aggregating 75,000,000 ft. b.m. Of these 500,000 ft. will be ordered from the Oregon mills, while the remainder will be purchased in Washington. The ties will be No. 1 common lumber, running about 40 ft. to the tie. The purchase price was $20 to $21 per 1000 ft. b.m. The specifications require heartwood. The ties are to be used on the New York Central, the Baltimore & Ohio, the Pennsylvania and other Eastern railroads.

Business Notes

The Chicago Bridge and Iron Co., Chicago, Ill., has moved its general sales office from the Chicago works to the 15th floor of the Old Colony Bldg., which quarters it occupied before the war.

The Philadelphia Vitrified Brick Co., Philadelphia, Penn., has been licensed to manufacture wire-cut lug paving brick by the Dunn Wire-Cut Lug Brick Co. of Conneaut, O., becoming the 75th licensee of that company. The Eastern works of the company are at Saxton, Penn.

The Dean Bros. Steam Pump Works of Indianapolis, Ind., has opened a sales office at 141 Broadway, New York City. H. Meacham has been appointed district sales manager.

The Reichert Mfg. Co., of Milwaukee, Wis., has changed its corporate name to the Metal Forms Corporation. The product will be the same as that manufactured heretofore, the new trade name being "Metaforms."

The Nichols-Moore Co., with offices at 11705 Detroit Ave., Cleveland, Ohio, has been organized to carry on a general advertising business. The organizers are Druses H. Nichols, formerly managing director of the Allied Publicity Bureau, and John C. Moore, formerly assistant director of the same organization.

Trade Publications

The Republic Creosoting Co., of Indianapolis, Ind., has issued a new catalog which gives scientific and practical information pertaining to creosote wood-block flooring, and its advantages in shop practice.

"How Business With Foreign Countries Is Financed" is the title of a pamphlet issued by the Guaranty Trust Co. of New York. It is published for the benefit of exporters and importers and others having business or financial relations with foreign countries. It contains 28 reproductions of specimen forms of drafts,

letters of credit, bills of lading, invoices and other documents generally used in connection with the financing of exports and imports, together with explanatory notes. It will be sent on request.

"Coaling Ships Mechanically" is the title of a handsomely illustrated 8½ x 11-in. booklet just issued by the Michener Storage Co., 17 Battery Place, New York City. The illustrations depict inside and outside apparatus for coaling large ocean liners.

The Taylor Instrument Co. of Rochester, N. Y., has just issued a general industrial catalog of Tycos instruments, containing 422 pages. The catalog contains useful information in regard to temperature-indicating, recording and control apparatus.

The Portable Machinery Co., of Passaic, N. J., has issued a folder on the subject, "Over 1000 Scoop Conveyors." The folder is illustrated and describes the loaders.

The American Lava Company, of Chattanooga, Tenn., has issued a 16-page pamphlet on the subject, "Lava for Mechanical and Electrical Purposes." The booklet describes the composition of the company's product, which is machined from mineral steatite.

"Truscon Standard Buildings" is the title of a booklet issued by the Truscon Steel Co., Detroit, Mich. Descriptions and illustrations of the various sizes of standard buildings made by the company are given.

Common Labor Becoming Scarcer

Only Lively Construction Can Prevent Serious Shortage — Labor Just Sufficient for Moderate Amount of Work Now Under Way

By Alden W. Welch

Common labor is not plentiful. Nationally, the situation is that there is just about enough common labor to supply the present moderate demand. If construction were normal there would be a serious scarcity. To those who look beyond the moment, the situation is worthy of serious consideration.

There are many indications that construction work will soon get under way in an encouraging volume. Prices of materials are high, but bids on construction projects do not appear to be excessive. In numerous instances they are less than the engineer's estimate.

PRESENT COST OF COMMON LABOR

	Rate per Eight Hour Day	Class of Common Labor
Atlanta	$2.44	City pays
Atlanta	2.40-2.68	Contractors pay
Baltimore	3.20-3.60	All
Baltimore	3.68	Shipyard
Boston	3.60	Concrete
Boston	3.60-4.00	Common
Dallas	2.40	Building
Dallas	2.50-2.80	City pays
Denver	3.50	City pays
Detroit	4.00	All
Kansas City	4.60	Common
Los Angeles	3.50-4.00	Common
Los Angeles	3.50-4.50	Wheelbarrow
Los Angeles	3.50-4.00	Sewer
Los Angeles	4.50	Hod Carriers
Los Angeles	4.00	Paving
New Orleans	2.40	Common
New York	4.00	Concrete
Pittsburgh	3.60	Common
St. Louis	2.00-2.16	Concrete
St. Louis	2.16-2.40	Brick
St. Louis	2.80	Sewer
St. Paul	3.60	Common
San Francisco	3.50-4.00	Nonunion

On Apr. 30, proposals were received in Albany, N. Y., on 19 highway projects. In every instance there were bids under the estimate. In most cases, all the bids were lower than the estimate.

Conceive of prices of construction materials falling to a more attractive level. A boom would probably result. Much labor would be needed. A shortage of common labor would ensue, and wages would advance.

The price of common labor varies throughout the country—as shown by the tabulation—and, in view of the cost of living, is nowhere excessive. The labor problem is not one of cost but of availability. A trip to the Federal Custom House in New York will discover a long line of aliens procuring passports to return to their native lands. One financial paper estimates that soon a million will have left New York, bearing with them $1,000,000,000 in money plus $1,500,000,000 in annual productive effort.

This heavy exodus is not being compensated for by immigration, which is practically at a standstill. During the war there came to this country not more than 1,000,000 workers—only 25% of the normal influx. This shortage, added to the million now leaving, creates a total shortage of 4,000,000. The longer construction work is put off, the more serious will become the labor situation.

North to South to West

Boston faces the likelihood of a carpenters' strike this month, as the union agreement lapsed May 1, when the carpenters were to ask $8 for eight hours' work, against the present $6.40. Concrete workers receive 45c. per hour; concrete laborers, 45, 47 and 50c. Stonecutters and quarrymen are on strike.

T. M. Barr, Federal director for Maryland of the United States Employment Service, states that the common-labor market in Baltimore is satisfactory—a steady stream of applicants, with employment for all. Wages average 40 to 45c. per hour.

In Atlanta, Ga., labor is not overabundant, though sufficient for present needs. The city pays $2.75 for a nine-hour day; contractors, $3 to $3.35 for 10 hours.

Dallas, Tex., reports just enough labor to supply present demand. The general opinion is, in view of the $17,000,000 worth of road bonds voted in Texas, that when work gets under way common labor will be very scarce.

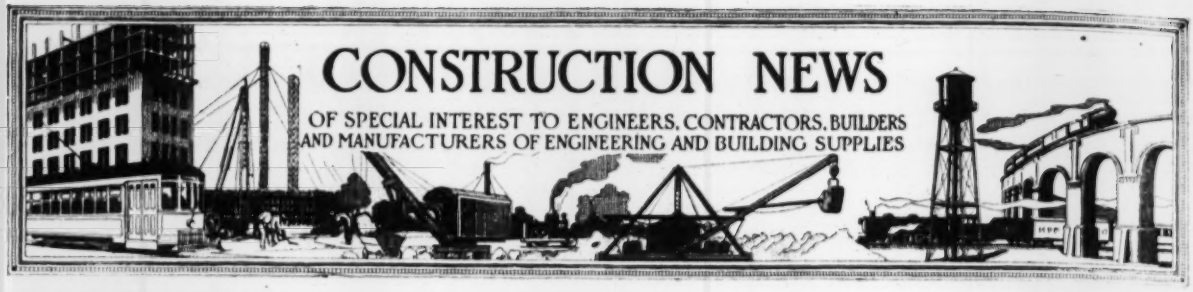
In the building trades in Kansas City, Mo., labor conditions are fairly normal. The War Labor Board has under consideration the demand of the structural iron workers. Plasterers and carriers are striking for 68¾c. per hour; but work is not delayed, because their places are being filled by building laborers at 57½c. Labor in paving work is plentiful, and this class of work is booming.

In Detroit, Mich., the supply of common labor just meets the demand. Contractors pay $5 for a 10-hour day.

Denver, Colo., reports excellent conditions in the labor market. There is a heavy demand for farm labor, not only in Colorado, but in Idaho and South Dakota as well, with offered wages of $50 to $60 a month, with board and lodging. Considerable building is under way in Denver, and in the building trades there is practically no idle labor. Bricklayers receive $7 for an eight-hour day, and expect to demand $8 this spring. Carpenters and painters are paid $6.40. Contractors complain of a shortage of common labor, especially for grading, teaming and mining. The city pays $3.50 for common labor. Telluride, near Denver, calls for 100 machine men, mine men and muckers. The railways are doing little new construction, but track men are in demand. Track work is usually lively at this season, owing to the winter damage in the mountain districts. The strike of the Leadville miners has been settled. The men resisted a decrease from $4.50 to $3.50, compromising on $4.

Since the adjustments reached by the employers and unions in San Francisco, Seattle and San Pedro, unemployment on the coast has greatly decreased. The total in California is 12,000 unemployed, of whom 7300 are laborers; in Washington, 7090; in Oregon, 4000. About half these men are unskilled laborers. Work in the country districts has improved; but the large corporations, including the public utilities, are undertaking no important projects.

In Los Angeles labor is usually plentiful, but not since the armistice has it been scarcer. The Employment Division of the United States Department of Labor reports a decrease in the number of unemployed since Mar. 15, when 9000 was the estimate. The absorption of the surplus of that class of labor used in construction, including building, has been especially rapid in the past few weeks. Agricultural activities have also claimed many men. There have been urgent calls, recently, for common labor on several highway contracts in southern California. Mexicans constitute about 15% of the supply. Before the war they received $1.25 to $2.50; the present rate is $3.50, and some are demanding $4, the prevailing rate for American labor. Plainly, the market is tightening.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

"For Proposals Advertised see the pages immediately following the Construction News Section."

WATERWORKS

Bids Close		See Eng. News-Record
May 13	Hollandale, Miss.	Apr. 17
May 13	Albert Lea, Minn.	May 8
May 14	Gilboa, N. Y.	Apr. 17
	Adv. Apr. 10 to 24.	
May 15	Fairmont, Minn.	May 8
May 27	Niles, Mich.	May 1
May 29	Tamaqua, Pa.	Apr. 24
	Adv. Apr. 24.	
June 2	Mankato, Minn.	May 1
	Adv. May 1.	

SEWERS

May 12	Pontiac, Mich.	Apr. 24
	Adv. Apr. 24.	
May 13	Newark, N. J.	Apr. 24
May 13	Frederick, Okla.	May 8
May 14	Humphrey, Neb.	May 1
May 14	Cleveland, O.	May 1
May 15	Litchfield, Minn.	May 8
May 15	Milwaukee, Wis.	May 8
May 16	Beloit, Wis.	May 8
May 17	Barberton, O.	May 8
May 19	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 19	Fresno, Cal.	May 8
May 20	Erie, Pa.	Apr. 24
	Adv. Apr. 24.	
May 21	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 22	Milwaukee, Wis.	May 8
May 27	Niles, Mich.	May 1

BRIDGES

May 12	St. Croix, Que.	May 1
May 12	Bright, Ont.	May 1
May 13	North Temiskaming, Que.	May 1
May 14	Rome, N. Y.	May 8
May 15	Valdosta, Ga	Apr. 24
May 15	Marion, Ia.	May 1
May 16	Thomasville, Ga.	Apr. 24
May 16	Watseka, Ill.	May 8
May 19	Cottonwood, Ariz.	Apr. 24
May 19	Jerome, Ariz.	May 1
May 19	Bowling Green, O.	May 1
May 19	Marysville, Wash.	May 8
May 19	La Fayette, Ga.	May 8
May 20	Macon, Ga.	May 1
May 27	Harrisburg, Ark.	May 8
	Adv. May 8.	
June 5	Stratford, Conn.	May 8
June 6	Monroe, Ga.	May 8
June 9	Montgomery, Ala.	May 8
	Adv. May 8.	

STREETS AND ROADS

May 9	Patchogue, N. Y.	Apr. 24
	Adv. Apr. 24.	
May 9	Trenton, N. J.	May 1
May 9	Ebensburg, Pa.	May 8
May 10	Pittsfield, Mass.	May 1
	Adv. May 1.	
May 12	Elk River, Minn.	Apr. 17
May 12	David City, Neb.	Apr. 24
May 12	Wahoo, Neb.	Apr. 24
May 12	St. Paul, Neb.	Apr. 24
May 12	New Jersey	Apr. 24
May 12	Salem, N. J.	Apr. 24
May 12	Great Falls, S. C.	May 1
May 12	Oneonta, N. Y.	May 1
May 12	Charleston, Wash.	May 1
May 12	Bremerton, Wash.	May 1
May 12	Hutchinson, Kan.	May 1
May 12	Seattle, Wash.	May 1
May 12	Duluth, Minn.	May 8
May 12	Gallitzen, Pa.	May 8
May 12	Paris, Ont.	May 8
May 12	Chicago, Ill.	May 8
May 13	North Bend, Ore.	May 8
May 13	Massachusetts	May 8
May 13	Boston, Mass.	May 8
May 13	Jersey City, N. J.	May 8
May 13	Buffalo, Minn.	May 8
May 13	Madisonville, Ky.	May 8
May 13	Toledo, O.	May 1
May 13	Beatrice, Neb.	Apr. 24
May 14	Arkansas	Apr. 17
	Adv. Apr. 17 and 24.	
May 14	Austin, Minn.	Apr. 24
May 14	Nebraska City, Neb.	Apr. 24
May 14	Humphrey, Neb.	Apr. 24
May 14	St. Catharines, Ont.	May 8
May 14	Helena, Mont.	May 1
May 14	Illinois	May 1
May 14	New Jersey	May 1
May 15	Sioux Falls, S. D.	May 1
May 15	Columbus, Tex.	May 1
May 15	Duluth, Minn.	May 1
May 15	Rushville, Neb.	Apr. 24
May 15	Hastings, Minn.	Apr. 24
May 15	Plymouth, Wis.	Apr. 10
May 15	Rome, Ga.	May 8
May 15	Bridgeville, Pa.	Apr. 24
May 15	New York	May 1
May 15	Lebanon, Pa.	May 1
	Adv. May 1.	
May 15	Terra Haute, Ind.	May 1
May 15	Cumberland, Md.	May 1
	Adv. May 1.	
May 16	Toronto, Ont.	Apr. 24
May 16	La Moure, N. D.	May 1
May 16	Newport, Pa.	May 8
May 16	Rhode Island	May 8
	Adv. May 8.	
May 17	Lincoln, Neb.	May 8
	Adv. May 8.	
May 17	Memico, Ont.	May 8
May 19	Merced, Cal.	Apr. 10
May 19	Tulsa, Okla.	Apr. 17
	Adv. Apr. 17 and 24.	
May 19	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 19	Minneapolis, Minn.	May 1
May 19	Plainfield, N. J.	May 8
May 19	California	May 8
May 19	Washington	May 8
May 19	Grafton, W. Va.	May 8
May 19	Brampton, Ont.	May 8
May 20	Windom, Minn.	Apr. 24
May 20	Brockton, Mass.	May 8
	Adv. May 8.	
May 20	Nutley, N. J.	May 8
May 20	Columbus, O.	May 8
May 20	Albemarle, N. C.	May 8
May 21	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 21	Preston, Minn.	May 8
May 21	Illinois	May 8
May 21	Ebensburg, Pa.	May 8
May 22	Benson, Minn.	May 1
May 22	Clay Center, Neb.	May 8
	Adv. May 8.	
May 22	Pittsburgh, Pa.	May 8
May 23	Lawrence, Kan.	May 1
May 26	Pennsylvania	May 8
	Adv. May 8.	
May 27	Preston, Minn.	May 1
May 27	Henderson, Minn.	May 8
May 27	Mahnomey, Minn.	May 8
May 27	Harrisburg, Ark.	May 8
	Adv. May 8.	
May 27	St. Louis, Mo.	May 8
May 28	Killmar, Minn.	May 8
May 28	Nashville, Tenn.	May 1
	Adv. May 1.	
May 29	Michigan	May 8
May 30	Dallas, Tex.	Apr. 17
	Adv. Apr. 17 and 24.	
June 1	Michigan	May 8
June 2	St. Severe, Que.	Apr. 24
June 2	Elkins, W. Va.	May 8
	Adv. May 8.	
June 3	Griffin, Ga.	May 8
June 3	New York, N. Y.	May 8
	Adv. May 8.	
June 10	Clarksville, Pa.	Apr. 3

EXCAVATION AND DREDGING

May 14	Sheboygan, Wis.	May 1
May 14	Poplar Bluff, Mo.	Apr. 3
May 15	Mobile, Ala.	Apr. 10
	Adv. Apr. 10 to 24.	
May 15	Sheboygan, Wis.	May 1
May 16	Grant City, Mo.	May 1
	Adv. May 1.	
June 2	Beaufort, N. C.	Apr. 24
	Adv. Apr. 24.	

INDUSTRIAL WORKS

May 10	Sheboygan, Wis.	Apr. 24
May 13	North Wittshire, P. E. I.	May 8
May 15	Toronto, Ont.	Apr. 24
May 15	Bemidji, Minn.	Apr. 17
June 15	Montreal, Que.	May 8
May 21	Guelph, Ont.	May 8
May 24	Brooklyn, N. Y.	May 8

BUILDINGS

May 10	Joplin, Mo.	May 8
May 10	Fergus Falls, Minn.	May 8
May 12	Trail, B. C.	May 8
May 12	Chambersburg, Pa.	May 8
May 12	Ironton, O.	May 1
	Adv. May 1.	
May 12	Flint, Mich.	Apr. 17
May 12	Hawley, Minn.	Apr. 24
May 13	Faribault, Minn.	May 8
May 15	Port Washington, Wis.	Apr. 24
May 15	Verona, N. J.	Apr. 10
May 15	Kearney, Minn.	Apr. 17
May 15	Winnebago, Minn.	Apr. 24
May 15	Sault Ste. Marie, Ont.	May 1
May 15	Farrell, Pa.	May 1
May 15	Montreal, Que.	May 8
May 15	Waterbury, Conn.	May 8
May 15	Franklin, O.	May 8
May 16	Round Lake, Minn.	May 8
May 16	Grand Rapids, Mich.	May 1
	Adv. May 1.	
May 17	Guelph, Ont.	May 8
May 17	Birmingham, Ala.	May 8
May 19	Charleston, S. C.	May 1
May 20	Cathay, N. D.	May 1
	Adv. May 1.	
May 21	Cohoes, N. Y.	May 1
May 21	Los Angeles, Cal.	May 8
May 22	Springfield, Mass.	May 8
May 26	Gallipolis, O.	May 1
June 1	Montreal, Que.	May 8
June 1	St. Cloud, Minn.	May 8
June 1	Rochester, Minn.	May 8
June 15	Anoka, Minn.	May 8

FEDERAL GOVERNMENT WORK

May 12	Dredging — New York, N. Y.	Apr. 10
	Adv. Apr. 10 to 24.	
May 12	Torpedo Storage Building —Spec. 3767 — Newport, R. I.	Apr. 24
May 12	Storehouse — Spec. 3842 — Charleston, S. C.	Apr. 24
May 12	Conduit System—Spec. 3846 —Pensacola, Fla.	Apr. 24
May 12	Buildings — Spec. 3855 — Paris Island, S. C.	May 1
May 15	Rip Rap—Baltimore, Md.	Apr. 17
	Adv. Apr. 10 to 24.	
May 15	Dredging — New Bedford, Mass.	Apr. 17
	Adv. Apr. 10 to 24.	
May 15	Grading — Washington, D. C.	May 8
May 15	Road Work — Kalispell, Mont.	May 8
May 15	Road Work—Hailey, Idaho	May 8
May 19	Dry Dock—Spec. 3858— Charleston, S. C.	Apr. 24
May 19	Elevators and shaft—Spec. 3851—Philadelphia, Pa.	May 1
May 19	Crane—Spec. 3869—Pensacola, Fla.	May 1
May 19	Cranes—Spec. 3670—South Charleston, Va.	May 8
May 20	Dredging — New London, Conn.	May 1
	Adv. May 1.	
May 20	Conduit, Wiring and Lighting Fixtures—Elgin, Ill.	May 1
	Adv. May 1.	
May 21	Dredging—Duluth, Minn.	Apr. 24
	Adv. Apr. 24.	
May 21	Derricks—Florence, Ala.	Apr. 24
	Adv. Apr. 24.	